U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

PB-292 546

Environmental Considerations in Water Resources Planning by The Corps of Engineers

Stanford Univ, CA

Prepared for

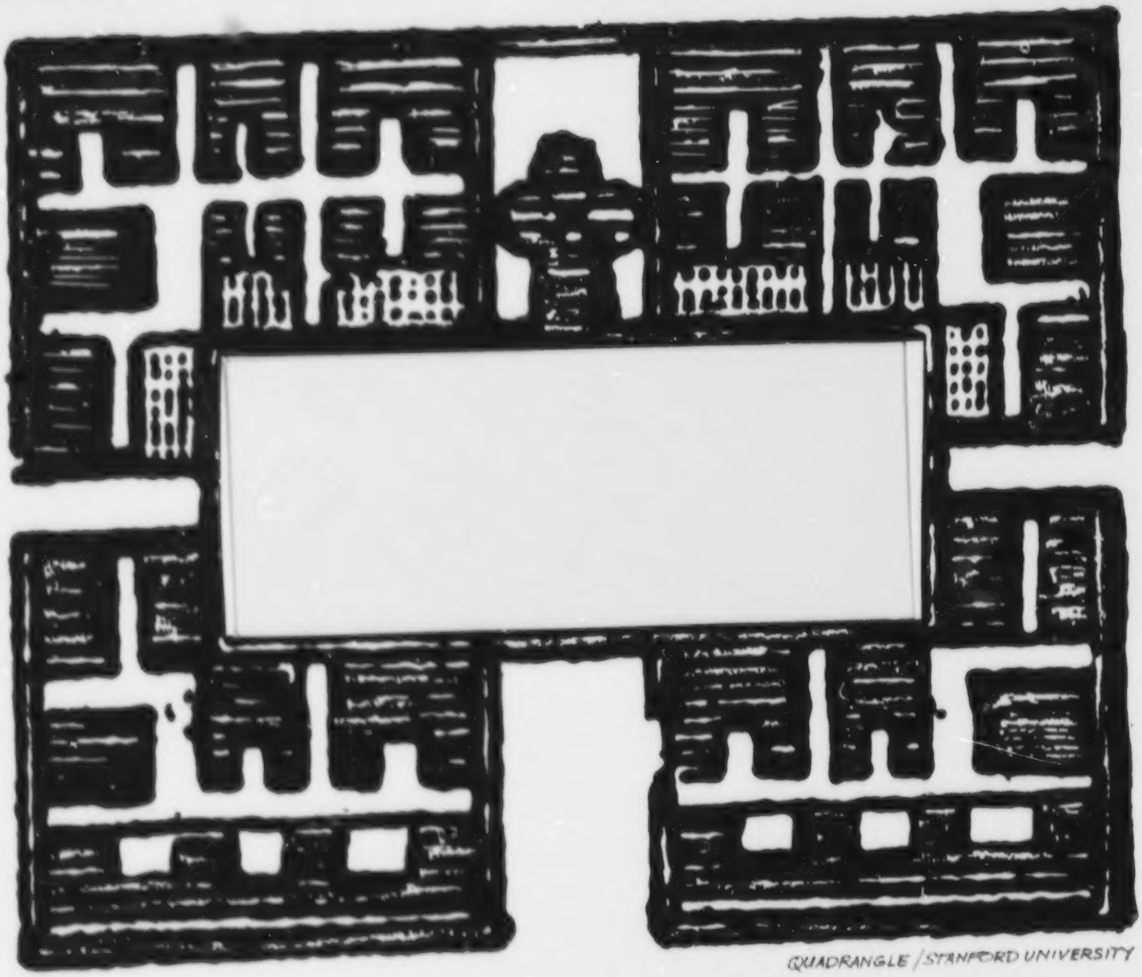
National Science Foundation, Washington, DC

Dec 78

NSF/PRA-7522340/2

PB 292546

INFRASTRUCTURE



QUADRANGLE / STANFORD UNIVERSITY

PLANNING & MANAGEMENT

DEPARTMENT OF CIVIL ENGINEERING STANFORD UNIVERSITY

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U. S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

50272-101

REPORT DOCUMENTATION PAGE

1. REPORT NO.
NSF/PRA-7522340/2

2.

Recipient's Accession No.
PB292546

4. Title and Subtitle
Environmental Considerations in Water Resources Planning by the Corps of Engineers

5. Report Date
December 1978

6.

7. Author(s)
C.M. Brendecke, L. Ortolano

8. Performing Organization Rept. No.
IPM-7

9. Performing Organization Name and Address
Stanford University
Department of Civil Engineering
Program in Infrastructure Planning and Management
Stanford, California 94305

10. Project/Task/Work Unit No.

11. Contract(C) or Grant(G) No.
(C)
(G) PRA7522340

12. Sponsoring Organization Name and Address
Scientific, Technological, and International Affairs (STIA)
National Science Foundation
1800 G Street, N.W.
Washington, DC 20550

13. Type of Report & Period Covered

14.

15. Supplementary Notes

16. Abstract (Limit: 200 words)

Organizational characteristics, planner attitudes, the conduct of agency coordination and public involvement, and the timing of the development of environmental information are examined. With regard to aspects of organizational structure, the findings suggest that leadership by members of the Corps hierarchy, particularly at the District level, may be very important to the increased consideration of environmental factors in survey investigations. It was also found that where the communication behavior of study managers and environmental specialists was more informal and interactive, connoting a more interdisciplinary approach to decision-making, environmental information exerted a greater influence on decision-making. Through case study interviews, it was observed that knowledgeable, environmentally concerned local citizens can be used effectively to develop a base of information on the potential adverse effects of alternatives considered in survey investigations. In relation to the timing of the development of environmental information, it was concluded that early interest group and public involvement activity is significantly related to greater consideration of environmental values in survey investigations. Guttman scaling and the ECHO value assessment technique were used to assess planner attitudes.

17. Document Analysis a. Descriptors

Project planning
Coordination
Environmental research
Environmental surveys
Data acquisition
Citizen participation
Interest groups
Water resources

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement
NTIS

19. Security Class (This Report)

20. Security Class (This Page)

21. No. of Pages
276

22. Price
A13-A01

(See ANSI-Z39.18) See Instructions on Reverse OPTIONAL FORM 272 (4-77)
(Formerly NTIS-35)
Department of Commerce

Program in Infrastructure Planning and Management
Department of Civil Engineering
Stanford University
Stanford, CA 94305

ENVIRONMENTAL CONSIDERATIONS IN WATER RESOURCES PLANNING BY THE CORPS OF ENGINEERS

By
Charles M. Brendecke
Leonard Ortolano

Report IPM-7
December 1978

This research was supported by funds provided by the National Science Foundation under Grant No. PRA-75-22340. The opinions, findings, conclusions, and recommendations expressed in this publication are those of the authors and do not necessarily reflect the views of the National Science Foundation.

ACKNOWLEDGEMENTS

The research reported herein is part of a larger research project supported by the National Science Foundation. The number of people who significantly contributed to its completion is so large that only a few can be mentioned here.

The overall research project, which included research in the Bureau of Reclamation and the California Department of Transportation as well as the Corps of Engineers, was well served by an Oversight Committee consisting of representatives, listed in Appendix C, of these agencies and others having a direct interest in Corps planning. The Committee Chairman, Malcolm Baldwin, of the President's Council on Environmental Quality, provided effective leadership and allowed us to gain the perspectives of potential users of the research results.

The research reported herein focuses exclusively on the Corps of Engineers. William J. Donovan, Chief of Plan Formulation and Evaluation in the Planning Division of the Office of the Chief of Engineers (OCE) in Washington, was instrumental in the execution of the research. Likewise, Robert W. Wolff, also of the Planning Division, OCE, provided essential contributions to the early stages of the research regarding population selection and sampling. Bob Sloan, of the South Pacific Division (SPD), San Francisco, was very helpful in arranging pretesting of the research design; Jake Harari and Chuck Leuthy of the San Francisco and Sacramento District offices within SPD also assisted in this regard. Special thanks, however, are due the many study managers and environmental specialists in the nine District offices visited who so generously contributed their time and provided many of the insights upon which this document is based. Water resources planning in today's environment of rapidly changing rules and conflicting demands is often a thankless job: it is to those who have accepted this challenge that this report is dedicated.

Other members of the research team also provided valuable contributions. Michael Ray, research team consultant from the Stanford Graduate School of Business, made many helpful recommendations regarding research design and data analysis. John Meersman and James Price shared their thoughts throughout the research concerning methodology and interpretation.

We are grateful for the guidance provided by our project monitor, G. Patrick Johnson of the National Science Foundation, and by the NSF Site Visit Team, chaired by Jiri Nehnevajsa of the University of Pittsburgh.

Finally, we would like to thank Kay Morton and Ditter Peschcke-Koedt, who helped with the early stages of typing, and especially Tina Bellandi, who completed the typing and put the report in its final form.

TABLE OF CONTENTS

Page

Acknowledgements ii

List of Figures vii

List of Tables viii

CHAPTER ONE. TOWARD THE INTEGRATION OF ENVIRONMENTAL FACTORS INTO THE PLANNING PROCESS 1

1.1 Stanford Research in Water Resources Planning 2

1.2 The Present Investigation 4

CHAPTER TWO. THE CORPS PLANNING PROCESS: AN OVERVIEW 6

2.1 Civil Works in the Corps of Engineers 6

2.2 Pre-authorization Planning 11

2.3 Post-authorization Planning 20

CHAPTER THREE. ELEMENTS OF RESEARCH DESIGN 26

3.1 Synopsis of Research Design 26

3.2 Population Selection and Sampling 27

3.3 Pretesting, Data Acquisition and Analysis 28

3.4 Internal Validity Considerations in the Research Design 35

3.5 External Validity Considerations in the Research Design 38

CHAPTER FOUR. ENVIRONMENTAL FACTORS IN CORPS DECISION MAKING: THE DEPENDENT VARIABLES 40

4.1 "Environmental" Considerations and Corps Civil Works Planning 40

4.2 Formulation Variable 41

4.3 Ranking Variable 47

4.4 Modification Variable 50

CHAPTER FIVE. ORGANIZATIONAL CLIMATE: ELEMENTS OF INTERNAL STRUCTURE AND PROCESS 56

5.1 Formal Organizational Design 56

5.2 Communication Behavior 63

5.3 Perceived Role 69

5.4 Conflict Resolution 71

Page

CHAPTER SIX. ENVIRONMENTAL ATTITUDES AND VALUES IN DECISION MAKING-- 75

6.1 Guttman Scaling-- 76

6.2 ECHO Value Assessment-- 86

6.3 Conclusions-- 97

CHAPTER SEVEN. INTERAGENCY COORDINATION AND PUBLIC INVOLVEMENT---- 99

7.1 Commitment to Obtaining Input-- 99

7.2 Generation of New Information-- 110

7.3 Perception of Pressure-- 117

7.4 Responsiveness to External Input-- 121

7.5 Multi-Variate Relationships-- 126

CHAPTER EIGHT. TIMING OF ENVIRONMENTAL COORDINATION AND STUDY----- 131

8.1 Timing of Agency and Public Involvement-- 132

8.2 Timing of ER Unit Information Gathering-- 137

CHAPTER NINE. A POSTERIORI HYPOTHESES CONCERNING THE INFLUENCE OF ENVIRONMENTAL INFORMATION-- 145

9.1 Pre-Authorization Planning Studies-- 147

9.2 Post-Authorization Planning Studies-- 159

CHAPTER TEN. SUMMARY AND CONCLUSIONS-- 171

10.1 Survey Investigations-- 172

10.2 Advanced Engineering and Design Studies-- 180

10.3 Policy Implications-- 185

10.4 Directions of Future Research-- 192

APPENDIX A. VARIABLE DEFINITIONS, MEASUREMENT AND SCORING--------- 196

A.1 DEPENDENT VARIABLES-- 197

A.2 INDEPENDENT VARIABLES: ORGANIZATION-- 209

A.3 INDEPENDENT VARIABLES: ATTITUDES AND VALUES-- 220

A.4 INDEPENDENT VARIABLES: EXTERNAL COORDINATION-- 227

A.5 INDEPENDENT VARIABLES: TIMING-- 237

A.6 ADDITIONAL VARIABLE CONCEPTS-- 243

Page

APPENDIX B. STATISTICAL TESTS USED IN THE ANALYSIS---------------- 247
B.1 SIMPLE RANK ORDER CORRELATION---------------------------- 247
B.2 TESTS FOR DIFFERENCE IN CENTRAL TENDENCY----------------- 252
B.3 PARTIAL RANK ORDER CORRELATION--------------------------- 256

APPENDIX C. MEMBERSHIP OF OVERSIGHT COMMITTEE-------------------- 260

APPENDIX D. REFERENCES--- 261

LIST OF FIGURES

Figure Page

2-1 Multiobjective Planning Process---------------------------- 13

4-1 Formulation Matrix Example-------------------------------- 44

4-2 Factors Influencing Selection of Plan-------------------- 48

4-3 Modifications to Authorized Plan------------------------- 53

6-1 Guttman Attitude Scales----------------------------------- 80

6-2 Categories of ECHO Value Responses for Study Managers----- 91

6-3 Sources of Praise and Criticism--------------------------- 93

6-4 Categories of ECHO Value Responses for Environmental Specialists-- 95

9-1 Pre-authorization Planning Decision Making Structure------ 149

9-2 Post-authorization Planning Decision Making Structure----- 160

A-1 Achievement of Planning Objectives------------------------ 199

A-2 Influence of Planning Constraints------------------------- 200

A-3 Factors Affecting Choice of Plan-------------------------- 203

A-4 Modifications to Authorized Plan-------------------------- 206

A-5 Alleviation of Adverse Effects---------------------------- 208

LIST OF TABLES

Table		Page
2-1	Milestones for Pre-authorization Study Management (i.e., Survey Investigations)	16
2-2	Milestones for Post-authorization Study Management (i.e., Advanced Engineering and Design)	22
4-1	Guidelines for Classification of Factors as Being "Environmental"	42
4-2	Planning Objectives and Constraints	43
4-3	Plan Modifications in Response to Environmental Considerations	52
5-1	Ratio of Sizes of ER and Planning Units	58
6-1	Guttman Scale Correlation Coefficients	84
7-1	Extent of Commitment to Obtaining External Input	103
7-2	Coordination Indices	104
8-1	Correlation Coefficients--Formulation vs. Timing of Agency and Public Involvement	135
8-2	Correlation Coefficients--Formulation vs. Timing of ER Unit Information Generation	141
9-1	Variables Used in the Multi-Variate Analysis of Pre-authorization Planning	151
9-2	Results of Multi-Variate Analysis of Pre-authorization Planning	153
9-3	Variables Used in the Multi-Variate Analysis of Post-authorization Planning	162
9-4	Results of Multi-Variate Analysis of Post-authorization Planning	164

Chapter One

TOWARD THE INTEGRATION OF ENVIRONMENTAL FACTORS INTO THE PLANNING PROCESS*

Any federal agency responsible for an action which significantly affects the quality of the human environment is required by the National Environmental Policy Act of 1969 (NEPA) to assess and consider the environmental impacts of the action. To comply with this law federal agencies engaged in the funding, planning, or construction of public works projects produce "Environmental Impact Statements" (EIS) which present an assessment and evaluation of the anticipated impacts of a given project and its feasible alternatives. To insure that its coverage is both thorough and comprehensive, an EIS must be circulated for review and comment to other agencies, interest groups and affected individuals. The intent of NEPA however, is broader than the production of public information documents. By requiring a careful impact assessment of all major public works projects, the legislation obligates agency planners to consider environmental factors along with traditional engineering and economic factors in making decisions concerning particular projects.

The objective of this research is to examine the role of environmental factors in water resources development planning by measuring the extent to which environmental factors influence decision making at the project-planning level in District offices of the U.S. Army Corps of Engineers, hereinafter referred to as the Corps. The research builds upon previous investigations of water resources development agencies conducted by Stanford University researchers to assist agencies in increasing the consideration given to environmental factors in planning and decision making (see Section 1.1 below).

The remainder of this chapter discusses research related to the role of environmental factors in water resources planning at the project level. First, it summarizes the Stanford University investigations upon which the research builds and then it presents an overview of the scope and design of the research reported on herein.

---

*Much of the text of this introductory chapter was originally developed by John Meersman of the Department of Civil Engineering, Stanford University, Stanford, California.

1.1 Stanford Research in Water Resources Planning

In the past seven years several investigations concerning the role of environmental information in project-level water resources planning have been carried out by researchers at Stanford University.* Detailed case studies of two U.S. Army Corps of Engineers projects by Randolph and Ortolano (1976) showed that the stage of a planning study at which environmental information is introduced can determine, to a large extent, the amount of influence which the information can have in planning decisions. In one planning study, its influence was limited to the inclusion of measures designed to mitigate the impacts of the proposed plan. Despite substantial controversy on the project, late-stage redesign was so severely constrained by previously concluded agreements and financial commitments that the original project proposal remained virtually unchanged except for mitigation measures. In the second case, environmental information was available in the early stages of the planning study, but its influence was limited by the study manager's apparent lack of enthusiasm for having environmental factors play a significant role in planning.** On the basis of ten less detailed case studies, Randolph (1976) hypothesized that three characteristics of an agency--organizational design, study managers' attitudes, and the level of "outside" pressure perceived by agency planners--were the major determinants of the extent to which environmental information influenced project planning.

In an effort to characterize how NEPA was being implemented, Hill and Ortolano (1975) administered mail questionnaires to 242 field-level planners of the Corps of Engineers and Soil Conservation Service. With regard to the formulation of alternatives, the questionnaire results indicated that although environmental assessments were sometimes used to suggest mitigation measures, they played no appreciable role in broadening the range of alternatives considered in a given study.* Similarly, environmental information appeared to have only a minor influence on the comparison of alternatives in that very few alternatives were eliminated from consideration on the basis of environmental factors (Hill, 1977).

---

*The following summary is adapted from a recent paper by Ortolano (1978).

**A "study manager" is the individual, most often a Civil Engineer by training, who is responsible for organizing and coordinating the efforts of various individuals and organizational units in the planning of a Corps of Engineers project.

In studying the organizational designs of the San Francisco District of the Corps of Engineers and the Santa Clara Valley Water District, Jenkins (1977) investigated the relative influence of various individuals and groups on the outcomes of water resources planning studies. He found that environmental specialists obliged to produce legally acceptable environmental documents rarely found time to become involved in project planning teams and that, as a result, their role in a planning study was generally limited to the task of writing impact statements, i.e., the role of environmental specialists in formulating and ranking alternatives was relatively minor.

Still another Stanford research study concerning the use of environmental information in water resources planning was started in 1972. In this case, researchers from the Department of Civil Engineering at Stanford worked in collaboration with the U.S. Army Corps of Engineers Institute for Water Resources (IWR). This group of researchers, concerned with designing a process for systematic consideration of environmental factors in decision making, developed a conceptual approach to water resources planning called the "Iterative, Open Planning Process," IOPP (Ortolano, 1974). The IOPP emphasizes both the need for public input in planning decisions and the desirability of a continuing reassessment of the objectives, constraints and alternative plans considered in water resources developments. The IOPP was tested by the Stanford/IWR researchers in a planning study conducted by the San Francisco District Office of the Corps of Engineers between 1973 and 1975 (Wagner and Ortolano, 1976). This test of the IOPP yielded several insights into the kinds of problems that may be encountered in conducting and utilizing environmental assessments. For one thing, it demonstrated that while the timing of key decisions was recognized as being important, the study manager lacked the authority to ensure that relevant assessments would be completed in time to really influence the outcome of the study. The research results also suggested that the kind of early, informal interagency coordination that could be very useful in conducting environmental assessments was not routinely undertaken; such coordination would have required special effort on the part of study managers. The research results also elaborated on the kinds of difficulties that could be involved in trying to have environmental specialists, engineers, economists, etc., work together on all aspects of a study in the context of an interdisciplinary team.

---

*This may have been partly due to the fact that, in the few years immediately following the passage of NEPA, agencies had to "catch-up", writing EISs for many projects which had already reached the late stages of planning.

These efforts by Stanford researchers have been valuable in several respects. First, they have shown how project-level planning is actually carried out in the field offices of federal water resources agencies. Second, using the techniques of survey research, they have identified characteristics specific to an agency and its planning procedure which appear to influence the use of environmental information in planning decisions. Finally, they have been used to develop practical suggestions as to how environmental factors might play a greater role in the planning of water resources projects.

1.2 The Present Investigation

The research reported on herein is part of a substantially larger effort involving the planning of water resources projects by the U.S. Army Corps of Engineers and the U.S. Bureau of Reclamation, and the planning of highway projects by the California Department of Transportation. Each of these studies built upon the above described research at Stanford and elsewhere to formulate and test hypotheses about how various characteristics of an agency's planning process influence the consideration of environmental factors in formulating and ranking alternative plans, and in modifying proposed projects.

The research reported on below concerns only that portion of this larger research effort that relates to the Corps of Engineers.* This investigation was initiated as an effort to determine the extent to which the hypotheses suggested by previous Stanford research were relevant to the planning of a broad range of Corps water resources projects across the nation. The research consisted of casting these hypotheses in operational terms and subjecting them to testing by examining them in light of information on twenty-eight randomly selected Corps planning studies carried out in eight District offices. The results from these cases provide insights into: (1) how relevant the aforementioned hypotheses are in the context of water resources planning throughout the Corps, and (2) how those hypotheses should be refined or elaborated. These results also provide the basis for a more precise research design involving future testing of the refined hypotheses.

---

*The portion of the larger research project concerning the Bureau of Reclamation has been reported on by Price and Ortolano (1978), and the research on highway planning by the California Department of Transportation is presented by Meersman, Ortolano and Shikuma (1978). A summary of the principal results from the entire project is given by Ortolano, _et al_. (1978).

The chapters below build upon one another in discussing how the research was carried out. Chapter 2 describes how water resources development planning is currently conducted in the District offices of the Corps, and Chapter 3 discusses aspects of the research design. Chapter 4 is devoted to a discussion of the three "dependent variables" defined and measured in this investigation. These variables represent the influence of environmental information on (1) the formulation of alternatives, (2) the ranking of alternatives, and (3) the modification of a Congressionally authorized plan. Each of the next four chapters presents one of the groups of "independent variables" examined in the research: Organization (Chapter 5), Attitudes (Chapter 6), External Coordination (Chapter 7) and Timing (Chapter 8). Each chapter contains a statement of the hypothesized relationships between the dependent variables and each of the independent variables in a variable group and presents the results of testing those hypotheses using the samples of water resources planning studies. Chapter 9 reports on an analysis of the combined effects of independent variables from different variable groups and Chapter 10 presents the conclusions that can be drawn from the Corps planning studies included in the research.

Chapter Two

THE CORPS PLANNING PROCESS: AN OVERVIEW

This chapter provides background information necessary for an understanding of the role environmental factors play in water resources planning and decision-making as discussed in subsequent chapters of this report. The chapter first briefly presents the history and basic organizational features of the Corps relating to water resources planning and the specific requirements related to environmental considerations. The last two sections describe in greater detail the pre- and post authorization planning processes in use at the time of the case study interviews, introducing the principal actors and terminology referred to in later chapters. It must be kept in mind that the rules governing the planning processes herein described are evolving over time. Procedural guidance has flourished in response to environmental mandates and, although the rates of change appear to be slackening, further refinements should be expected (Corps, 1977b). Thus the planning process described herein should be viewed as a "snapshot" and interpretations of research findings applied to the process at the present time should bear this in mind.

2.1 Civil Works in the Corps of Engineers

The Army Corps of Engineers has been in existence since 1775, but authority for its first water resources function came in 1824 when involvement in navigation improvements began. Over the years Congress authorized flood control improvements on specific rivers and in the Flood Control Act of 1936* gave the Corps formal authority over flood control planning. Subsequent acts of Congress have increased the authority of the Corps so that today the "Civil Works Program" of the Corps of Engineers encompasses "a broad range of resource [planning and] development activities for navigation, flood control, major drainage, shore and beach restoration and protection, hurricane flood protection, related hydroelectric power development, water supply, water quality control, fish and wildlife conservation and enhancement, outdoor recreation and environmental quality" (Water Resources Council, 1971, p. 3-1). The Civil Works Program (one of five principal programs within the Corps) now has, in its active program of projects and project authorizations, a capital investment of over $40 billion and an annual operating budget on the order of $2.5 billion (OMB, 1978).

---

*P.L. 74-738, sec. 1-3, as amended (33 U.S.C. 701).

Organizational Overview

The Office of the Chief of Engineers (OCE) in Washington implements Corps programs through a hierarchy of Division and District offices. Division offices largely provide support and review functions for the District offices within their jurisdiction. There are presently 11 Division offices (in the United States) and 36 District offices. Two of the eleven Divisions, New England and Pacific Ocean, have no District offices and act as Operating Divisions. Since planning takes place at the District level, the two operating Divisions were considered as District offices for the purposes of this research. This hierarchy of Divisions and Districts has the primary responsibility for implementing the Civil Works Program of the Corps.*

The types of planning studies conducted under the Civil Works Program fall generally into three categories. Level A studies are "framework studies" of regional or national scope directed by the Water Resources Council (WRC). Also directed by the WRC are level B studies, which address regional or river basin land and water resource needs providing somewhat greater detail than level A studies. Level C studies, those examined in this research, are implementation studies of specific problems and needs evaluated by the level A and B studies or requested by Congress. Level C studies are primarily directed by the Corps through its District offices and are the largest single element of the total planning budget. They are the most "visible" aspect of Corps water resources planning since they often result in the authorization and construction of projects on a local level. Thus the environmental controversies surrounding the Corps in recent years have, by and large, been focused on planning or construction associated with these implementation studies. For these reasons they are the primary subjects of this research.

---

*The other programs, such as military construction, were not examined as part of this research.

Level C studies take the form of pre-authorization studies, or "Survey Investigations," which are largely feasibility studies (or in some cases re-studies) of water resource problems aimed at determining the most appropriate* Federal action, and post-authorization studies, or "Advanced Engineering and Design" (AE&D) studies, aimed at refining and verifying the findings of feasibility studies and preparing detailed engineering plans. Survey Investigations and Phase 1 post-authorization studies (the first stage of AE&D planning) represent the two types of planning studies examined in this research.

The Life Cycle of a Level C Study**

A Survey Investigation is initiated when Congress authorizes the study of a particular water resource problem through an omnibus bill, a committee resolution, or a specific act. This authorization is in response to requests from local interests expressed directly to Congressmen or through the Corps of Engineers. Actual planning begins when funding is allocated to the appropriate District to begin studies. The District Engineer then directs his staff to develop, in cooperation with local interests and other agencies, a Survey Report defining the water and land resource problems addressed and describing methods of solution. If technically feasible and economically justifiable methods can be devised, the Survey Report recommends a specific proposal which is acceptable to local sponsors (municipalities, special districts, or state agencies who must satisfy some cost-sharing requirements). This recommendation is then subjected to higher level review and Congressional scrutiny. Congress may then authorize more detailed study of the problems or construction of the recommended plan of action. If the former, the District Engineer directs his staff to prepare, in cooperation with local interests and other agencies, a Phase 1 General Design Memorandum (GDM), the analogue of the Survey Report, reaffirming or reformulating the previously recommended and authorized plan. Subject to review approval and possibly a second Congressional authorization, the Phase 1 GDM provides the basis for preparation of detailed plans and eventual construction. The average elapsed time from initial Congressional authorization of the Survey Investigation to project completion is on the order of 24 years.* The District level planning process leading up to the Survey Report corresponds to the pre-authorization studies investigated herein while the District level process leading up to the Phase 1 GDM corresponds to the post-authorization studies investigated herein.**

---

*Survey Reports may recommend either "no Federal action" or implementation of a particular proposal. If the latter, the proposal, at a minimum, must exhibit a benefit-cost ratio greater than one and be "environmentally acceptable."

**More detailed discussion of the procedures used for the two types of studies investigated is provided in Section 2.2 and 2.3.

Environmental Mandates Affecting Corps Planning

The National Environmental Policy Act of 1969 (NEPA) has probably had the most significant impact on Corps planning (and planning by a great many other agencies for that matter) of any piece of recent legislation. Its requirement of an environmental impact statement (EIS) for "major Federal actions significantly affecting the human environment..." has led to a flurry of activity to develop procedural guidance for agency compliance. So much so that it is easy to lose sight of the policy intent of the Act "to use all practicable means and measures....in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans." The Council on Environmental Quality (CEQ), charged with preparing guidelines for NEPA's implementation, directed each federal agency to establish its own formal procedures for implementing the requirements set forth in those guidelines, including procedures for "consulting with and taking account of the comments of appropriate federal, state, and local agencies and the public..." (CEQ, 1973, sec. 1500.3(a)). In the Corps this has resulted in considerable increases in District staff with expertise in environmental sciences (Hill, 1977) whose duty it is to prepare and circulate, according to highly formalized procedures, the EIS's for various projects to other agencies and public interests. This has led to increased dialogue with environmentally concerned agencies and publics (Hill and Ortolano, 1975) and has opened up new channels of influence in the Corps decision making structure to environmental interests.

---

*The median elapsed time is 18 years.

**Throughout this report the terms "pre-authorization study", "feasibility study" and "recent study" are used interchangeably to describe Survey Investigations while the terms "post-authorization study", "Phase I study" and "older study" are used to describe the process leading up to the Phase I General Design Memoranda.

But the EIS is more than a report which is reviewed and revised, it is an information generating device which provides a wide range of data to decision-makers heretofore accustomed to relying mainly on technical and economic considerations. Preparation of an EIS typically involves field studies* and literature reviews of environmental resources such as aquatic flora and fauna, terrestrial vegetation and wildlife populations, chemical quality of water and sediments, and cultural, historical, and archeological areas of interest. Considerable information is gathered as well, in dialogues between planners and knowledgeable local interests as well as environmental or conservation agencies at the Federal and state level.

The Principles and Standards for the Planning of Water and Related Land Resources (P&S) promulgated by the Water Resources Council in 1973 has also significantly influenced the consideration given environmental factors in Corps planning (WRC, 1973). The P&S defined four planning "accounts", namely, National Economic Development (NED), Environmental Quality (EQ), Regional Development (RD), and Social Well-Being (SWB), which are to guide the plan evaluation processes of the Federal agencies having jurisdiction over the nations waterways. Presently, however, only the first two, NED and EQ, have been designated as national planning objectives. This represents the first formal statement that environmental considerations receive equal emphasis with economic factors in project planning. Previously the maximization of excess economic benefit had been the dominating rule.

Corps guidance in response to the P&S requires that plans emphasizing EQ be identified, in most situations, to complement economically oriented plans and highlight the ways in which water resources goals can be met while preserving and enhancing environmental values. This has resulted, to some degree, in the increased involvement of environmental specialists in decision-making and an increased perception of EQ as a planning goal. But perhaps the most important result of the P&S has been the adoption by the Corps of a multi-objective planning process (Corps, 1975). The "200-series" regulations promulgated by OCE operationally define the goals of the P&S and adopt an 'iterative, open planning process', described in greater detail below, wherein the classical decision making tasks of problem definition, alternative formulation, impact assessment and plan evaluation are repeated cyclically in increasing detail until a plan emerges that best satisfies the NED and EQ objectives of the P&S. The importance of input from outside interests is underscored by these procedures and they have encouraged dialogue between planners and environmental specialists within the Corps.

---

*The level of detail of such studies is highly variable ranging from "windshield surveys" to detailed sampling and analysis over several years.

Other legislative mandates requiring increased attention to environmental matters include the River and Harbor and Flood Control Act of 1970, a fore-runner of the P&S which, in Sec. 122, describes the types of impacts to be addressed by Corps planners and sets environmental quality as a goal. The Federal Water Pollution Control Act Amendments of 1972 linked water quality concerns to the traditional aspects of resource management planning addressed by the Corps. Earlier, the Historic Preservation Act, the Endangered Species Act, and the Fish and Wildlife Coordination Act had served to initiate increased consideration of environmental factors.

The effect of all these mandates has been synergistic, the whole being more than the sum of the parts. They have resulted in a substantial increase in the political strength of a broad constituency of environmentally concerned individuals and organizations and the Corps has found this constituency increasingly influential. The last two sections of this chapter describe in greater detail the framework in which consideration of environmental factors takes place in Corps planning.

2.2 Pre-Authorization Planning*

Corps level C planning can best be understood as a product of two primary influences: 1) regulations defining the planning process per se, and

---

*Discussion in this section relies heavily on the previous work of Randolph (1976) and Hill (1977), formerly of Stanford University.

2) regulations defining procedures for the management of planning studies. The former present guidelines regarding the identification of planning objectives, the development of alternative plans, the assessment of effects of alternatives, and the evaluation and selection of a recommended plan; the latter define a framework by which study progress is monitored and evaluated, and set out a sequence of "milestones" indicating the points at which significant events or procedures, e.g., review of findings by superiors, are to occur. The discussion below first briefly describes the general planning process, which is applicable to both Survey Investigations and Phase I AE&D studies, and then discusses the management framework for Survey Investigations.

As indicated in Figure 2-1, the planning process is an iterative procedure in which four functional planning tasks, problem identification (or problem definition), alternative formulation, impact assessment, and evaluation, are carried out over three stages of increasing detail. Each of the four functional planning tasks receives a somewhat different emphasis in each of the three stages; this relative emphasis is indicated in Figure 2-1 by the size of the box surrounding each task. The problem identification task is meant to determine the range of water resource problems to be addressed and to give direction to subsequent planning activity. The problems to be addressed are to be ascertained by obtaining the views of the general public, interest groups, and other agencies, by considering relevant national policies and the study authority itself, and by analyzing previously established water needs and priorities. This information is then used to define the geographic area to be studied (the "study area") and to describe the "base condition", i.e., the existing water and land uses and their economic, environmental, and social characteristics. Drawing on the base condition analysis and expressed public concerns, "alternative futures" for the study area are to be projected and a "most probable future" selected. From this information specific planning objectives for the study are developed.

The formulation of alternatives task is meant to develop different resource management plans which address the specific planning objectives and, through them, the national objectives of NED and EQ. Initially a range of measures, structural and non-structural, which may potentially satisfy the planning objectives, are to be identified. These measures

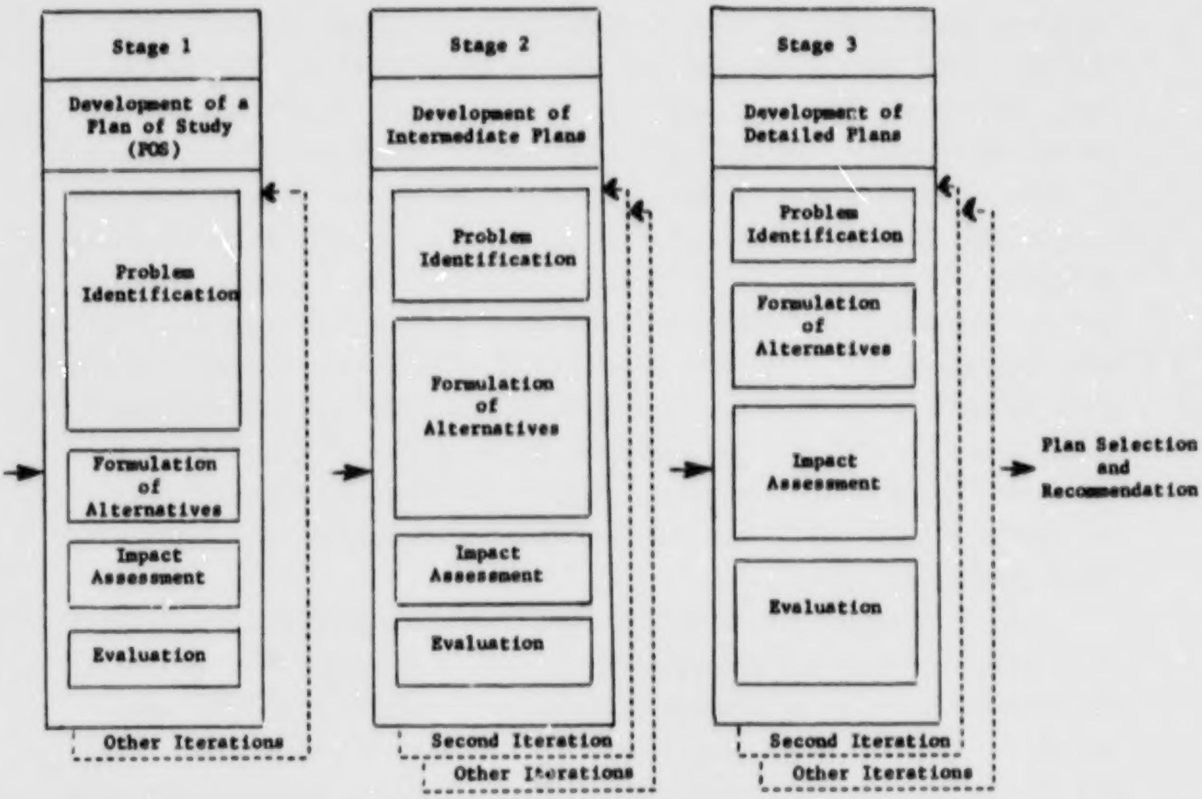

Stage 1
Development of a Plan of Study (POS)
Problem Identification
Formulation of Alternatives
Impact Assessment
Evaluation
Other Iterations
Stage 2
Development of Intermediate Plans
Problem Identification
Formulation of Alternatives
Impact Assessment
Evaluation
Second Iteration
Other Iterations
Stage 3
Development of Detailed Plans
Problem Identification
Formulation of Alternatives
Impact Assessment
Evaluation
Second Iteration
Other Iterations
Plan Selection and Recommendation

Figure 2-1 Multiobjective Planning Process

Source: ER 1105-2-200, "Multiobjective Planning Framework", (Corps, 1975).

are to include ideas proposed by other governmental and non-governmental interests. Measures are then compared against one another, in terms of the planning objectives, and linked or combined into a range of alternative plans.

The impact assessment task is meant to describe the effects of the various alternative plans on the "base condition". The effects to be addressed are all those economic, social, and environmental consequences "likely to have a material bearing on the decision making process". The aspects of the various alternatives causing these effects are to be identified, the effects traced out and specified as to geographical incidence, and the magnitude of the various effects characterized in appropriate units.

The evaluation task is meant to analyze the effects of each plan relative to the "without condition*" and against other plans. It is to assign values to the effects of the various alternatives. This value assignment is achieved through appraising the contribution of each plan to the planning objectives and to the NED, EQ, SWB, and RD national accounts. In addition, specific evaluation criteria, such as acceptability, benefit-cost ratio, and reversibility, are applied. Trade-off analysis is then to be conducted, based on the evaluation criteria and views of affected parties, NED and EQ plan(s) designated, and the need for repitition of any planning tasks determined.

Once a candidate set of NED, EQ, and combined NED/EQ plans are identified, plan selection and recommendation criteria are applied. The District Engineer selects that plan which best serves the public interest, based on public response to the plans resulting from the evaluation task. Two basic criteria apply to plan recommendation: 1) the recommended plan must, except in highly unusual circumstances of overriding social or environmental concern, exhibit net economic benefit, and 2) it must be either completely within the implementing authority of the Corps of Engineers or be otherwise responsive to the planning objectives and approved, in advance, by OCE.** The planning process described above is superimposed over a study management framework discussed below. It should be noted that, in practice, the process described above may conflict with study management procedures. Several Corps participants in the research remarked that it was often difficult to integrate the iterative nature of the planning tasks described above with the sequential nature of study management regulations.

---

*The "without condition" is that future condition which would ensue in the absence of any action to alter the management of water resources.

**This latter case appears to be quite rare.

Table 2-1 indicates the general framework of pre-authorization study management leading to the submission of Survey Reports to the Congress. As previously mentioned, the initiation of a Survey Investigation begins with the Congress as a response to locally expressed needs. Some years may elapse between the time Congress authorizes an investigation and the time funding is allocated to the responsible District. Once the planning funds are available, the District Engineer assigns responsibility for coordinating the study to a study manager, typically a civil engineer in the Planning Branch (or Division) of the District office. The study manager then arranges, with the cooperation of the local sponsor, the initial public meeting (milestone 1 on Table 2-1). This meeting is one of three formal public meetings required in the pre-authorization process. This meeting is typically quite formal, presided over by the District Engineer and recorded verbatim for public record. Views presented are most often those of officials and organized groups although individuals do have the opportunity to make comments. The meeting is designed to generate information as to the problems and needs to be addressed as well as environmental issues impinging on the study. It also serves to open channels of communication with local interests.

The study manager then proceeds to develop the necessary information to formulate plans which will address the perceived local needs in accordance with Congressional authority. The scope of this formulation is determined largely by the authorizing act, which may indicate that either a single purpose (e.g., flood protection or navigation improvement) or multiple purposes are to be considered. Multiple purpose authorization considerably increases the scope of planning often to include other water resources objectives and outdoor recreation measures. Technical information relating to hydrology, economics, demand forecasts, geology, and the like are obtained from other organizational elements within the District and from some outside sources. Information relating to environmental issues is obtained largely from an Environmental Branch (or Section) within the District. Typically responsibility for developing this information is given to a single individual within the Environmental unit, who will henceforth be referred to as the environmental specialist. The job of the environmental specialist is to ascertain the environmental information needs of the study and conduct such field investigations and literature reviews as are necessary to obtain that

TABLE 2-1

MILESTONES FOR PRE-AUTHORIZATION STUDY MANAGEMENT
(i.e. SURVEY INVESTIGATION)

1. Initial Public Meeting.
   This meeting is to advise the other agencies and the public of the nature and scope of the study, to open lines of communication, listen to the needs and views of those present, and to identify "interested parties," which would be included on an interested parties list.

2. Preparation and Approval of Plan of Study.
   The plan of study provides basic information on the study and a plan of action for those who will do the work. It also serves as a document to be reviewed and approved by the Division and OCE and a document to be reviewed and commented on by other agencies and local interests.

3. Preparation and Submission of Phase I of Study Project to Division.
   Phase I (or preliminary feasibility study) reports are non-detailed reports whose primary purpose is to identify the problems and needs of the study area, and develop, design, and evaluate practical alternatives in sufficient detail to determine whether a more detailed (i.e., Phase II) study of any alternative(s) is warranted.

4. Check Point I Conference.
   This conference between District and Division (and usually OCE) staff is used to discuss and evaluate study progress, preliminary study results, and other matters related to the study (e.g., procedures used in identifying economic, social, and environmental effects; interagency coordination and public involvement; and the plan formulation rationale). Investigations may be redirected or expanded as a result of this conference.

5. Formulation Stage Public Meeting.
   This meeting is held when all alternative solutions are delineated but before a plan has been tentatively selected.

6. Check Point II Conference.
   This conference between District and Division (and usually, OCE) staff is used to discuss and resolve plan formulation and other study issues and to check key factors regarding the adequacy of the investigation and analyses.

7. Preparation and Submission of Survey Report Draft to Division.
   The draft survey report presents detailed studies but does not necessarily arrive at a conclusion regarding a recommended action.

8. Division Review of Survey Report Draft.
   The Division reviews the draft and submits written comments to the District.

TABLE 2-1 (CONT.)

9. Late Stage Public Meeting.
This meeting is held after detailed studies but before completion of the survey report. Findings and tentative recommendations are presented.

10. Finalization and Submission of Survey Report, EIS and SOF.
The report demonstrates that a proposed project will meet the needs of the people concerned, has their support, and produces the "optimum" use of the natural resources required for its realization. The environmental impact statement (revised draft) and statement of findings (SOF) are also submitted. The SOF sets out in a logical manner for the public record the factors which led the District Engineer to his conclusions and recommendations.

11. Division Review and Issuance of Public Notice.
A public notice of the release of the survey report is issued by the Division.

Sources: OCE, ER 18-2-2, Intensive Management Program Monitor System 1 August 1974.

OCE, EM 1120-2-101, Survey Investigations and Reports, General Procedures.

OCE, BERH, Planner Orientation Course, May 1974.

Adapted from Randolph and Ortolano (1975, p. A-4).

---

information. In practice, he is limited to a large degree in these pursuits by the direction of the study manager and the District hierarchy. Typically, he is almost totally constrained until the ability of planners to devise economically feasible plans is ascertained. Concurrently, the study manager, in collaboration with people from these other organizational elements and local interests, describes first the general alternative concepts to be investigated and later more detailed proposals. The extent of influence of other District personnel, particularly environmental specialists, on the process of generating alternatives is highly variable, depending on personalities, District policies, and time/budget constraints.

The study manager also has considerable discretion in determining the extent of public involvement used in the study. In addition to the three required public meetings he may meet or converse informally with local sponsors (e.g., state, county, or municipal officials) and other local interests (e.g., sportsmens clubs, civic organizations, environmental groups) as well as other state and Federal agencies. He may also implement more structured public involvement measures, such as workshops or seminars, to obtain more information relevant to the study. (The influence of these outside sources and the environmental specialist in determining the consideration given environmental factors through the plan formulation process is specifically investigated in subsequent chapters of this report.)

Milestone 4 of Table 2-1 is the checkpoint I Conference. Here the initially developed study alternatives are reviewed in light of the information available and the direction of subsequent planning efforts discussed. Typically some narrowing of the number of alternatives under consideration is accomplished here although no explicit choices are made. Subsequently the study manager coordinates the further development of information and more detailed project formulations.

The formulation stage public meeting, milestone 5 in Table 2-1, is another required and generally formalized meeting in which the range of alternatives thought to represent the 'best' feasible solutions are publicly discussed. In some cases the meeting may be used as a forum upon which to base selection decisions while in other cases it is primarily a public information device. Views of officials and individuals are again transcribed for public record. Information gained from this meeting may be used to further refine project formulations or open up new avenues of study.

Superimposed over these activities are those of the environmental specialist, who may be preparing the text of a draft EIS (or other pre-EIS environmental document) for review by other agencies and interests. (The extent to which environmental documents are prepared and circulated during the early stages of the study is another aspect specifically investigated in this research.) Summaries of environmental considerations are prepared for use at the Checkpoint 1 conference and the formulation stage public meeting, although these are usually not of great detail. More detailed environmental documentation is a variable unique to each study although some Districts and Divisions have specific policies in this regard. For example, the South Pacific Division requires the preparation of an Environmental Working Paper, an EIS type document which is circulated 'while a range of alternatives is still under consideration' (Randolph, 1976, p. A-7). This circulation can occur as early as milestone 3, where a preliminary study of the feasibility of alternatives is completed.

The Checkpoint 2 Conference (milestone 6 in Table 2-1) between District planners and Division (and sometimes OCE) reviewers frequently results in unofficial tentative agreement on the plan to be addressed as the selected plan in the Survey Report,providing no substantial controversies or questions exist. The preparation of the draft Survey Report and the accompanying draft EIS follow the Checkpoint 2 Conference. The Survey Report usually addresses the proposed plan of action, giving relevant technical and other data, and discusses briefly other alternatives considered. A section on the environmental impacts of the proposed plan is included but the draft EIS provides the primary information on these factors.* The draft Survey Report and draft EIS are then submitted to the Division for review.

If no deficiencies are noted in the two draft reports they are then typically sent out for review by federal and state agencies, local sponsors, and others on the study mailing list. Usually the draft EIS receives wider distribution than the draft Survey Report. After these reports have had opportunity for outside review and comment a final public meeting is held (milestone 9 in Table 2-1) at which the proposed plan is presented and comments entertained. Additional copies of the draft EIS may be available at this meeting. Barring substantial controversy at this point a final Survey Report and a revised draft EIS are prepared for multiple internal reviews by the Division office, the Board of Engineers for Rivers and Harbors (BERH) and OCE. If these reviews result in requests for further analysis or revisions to the reports, then revisions are incorporated into the documents by the District Engineer. If substantial changes in the reports are made, a second revised draft EIS may then be made available for public and agency review and comment. Comments received on the revised draft EIS are then incorporated and the final EIS is submitted along with the final Survey Report to OCE. From there the reports go through the Secretary of the Army and to the Office of Management and Budget (OMB) and thence to the Congress. This is essentially the last step in the pre-authorization reporting process.

---

*New regulations stipulate that the EIS actually be bound into the Survey Report (Corps, 1978).

The actual process of developing and evaluating alternatives is, in practice, complete at the time of the submission of the draft Survey Report to the Division (milestone 7 in Table 2-1) although modifications are not infrequently made as a result of the extensive review process. Thus this "milestone" was used as the primary criteria for selecting pre-authorization studies to be examined by this research. The bulk of public involvement and environmental study activity is usually completed at this stage and at least a verbal consensus has been achieved with local sponsors, who must provide rights-of-way and easements and share a portion of project costs. The entire pre-authorization process takes on the average of 4½ years. In the studies included in this research the duration ranged from 2 to 9 years. In two of the fourteen pre-authorization studies examined no economically feasible and locally supportable plans could be found and "no Federal action" was the recommendation of the Survey Report. Many study managers participating in the field interviews noted that the proportion of infeasible studies was much higher than that noted above. The next section describes the post-authorization process leading to the Phase I GDM.

2.3 Post-Authorization Planning*

The post-authorization planning process is, like that of Survey Investigations, a product of regulations which define a planning process and regulations which specify study management procedures. The planning process is the same as that described in Section 2.2 above, however, it may be abbreviated or only specific aspects of it may receive major emphasis depending on the date at which the project was authorized by Congress, the extent of change contemplated in the authorized project, and whether or not the Survey Investigation leading to the authorized project was conducted utilizing the iterative planning process. The study management procedures for post authorization studies are, however, substantially different from those of pre-authorization planning.

---

*This discussion draws heavily on the work of Randolph (1976).

Table 2-2 indicates the general framework of post-authorization study management leading, eventually, to the preparation of plans for construction. The portion of the post-authorization process of primary interest in this investigation is that up to and including milestone 6 (Table 2-2). The process after milestone 6 is concerned with detailed design questions not of interest in the present research. It is important to note milestone 7, however, which indicates that the findings of some Phase 1 General Design Memoranda (GDM) may be subject to Congressional review. Thus both planning processes investigated in this research may lead ultimately to the Congress. Recent guidance however, provides that certain projects may bypass this second Congressional authorization (Corps, 1977a).

Plans recommended in Survey Reports may be straightforwardly authorized by the Congress, may not be authorized, or may be conditionally authorized. The latter case is unusual although such a case was included in the sample of post-authorization studies examined.* If a plan receives Congressional authorization responsibility for Phase 1 planning is again delegated by OCE to the District Engineer who assigns the study to a study manager. Depending on the amount of time which has elapsed since the feasibility investigation, the presence of new issues or problems, or other changed conditions a decision is then made whether to pursue the Phase 1 process as a "reaffirmation" study or a "reformulation" study (Corps, 1977a). Where few revisions are anticipated to the authorized plan the former option is adopted. If the latter is adopted, it sets the stage for a greater amount of public involvement, agency coordination and perhaps environmental study than would be the case under the "reaffirmation" option.

The study manager then prepares a Reconaissance Report which outlines the activities to be undertaken during the Phase 1 process and which is subject to Division approval (milestone 1 in Table 2-2). With this approval the study manager then coordinates the gathering of more detailed project information from the various organizational elements within the District including the environmental specialist. An examination, of varying depth,

---

*In this case a serious environmental controversy surfaced at the last public meeting of the Survey Investigati[illegible] The subsequent authorization stipulated that this controversy be resolved through use of an interagency task force before further planning was undertaken.

TABLE 2-2

MILESTONES FOR POST-AUTHORIZATION STUDY MANAGEMENT
(i.e. ADVANCED ENGINEERING AND DESIGN)

1. Submit Plan of Study for Division Approval.
   The Plan of Study outlines the procedures, studies, costs, schedules, etc.,for accomplishing AE&D.

2. Plan Formulation Conference.
   This conference with Division and OCE occurs at least 90 days prior to District submission of Phase I GDM. By coordinating with OCE at this stage it is possible to minimize the need for major revisions later.

3. Submit Draft Phase I General Design Memorandums and Draft EIS.
   The first phase of the post authorization process yields the Phase I GDM or "Plan Formulation Memorandum" which is prepared by District planners. Appropriate studies and investigations are made to either reaffirm the authorized project, or reformulate the project to meet present day conditions and/or criteria. The Phase I GDM is essentially an extension of the survey report. A Draft environmental statement is submitted to the Division with the Draft Phase I GDM.

4. Public Meeting.
   One or more public meetings or workshops are held during post authorization planning studies to insure that views of interested parties will be considered in the development of the plan and that all interested parties will be kept informed of study progress.

5. Plan Formulation Review Conference.
   This conference with Division and OCE is held to insure the adequacy of the tentative plan prior to the preparation of the final Phase I GDM and EIS.

6. Finalization and Submission of Phase I GDM, revised EIS, and SOF.
   The Phase I GDM, Statement of Findings (SOF), and fully coordinated revised EIS are submitted to OCE.

7. OCE Review and Approval.

   Congressional Approval of Phase I GDM.
   Wording contained in section 1(b) of PL 93-251 has been interpreted to mean that Congress will want most Phase I GDM's submitted to them for approval.

8. General Design Conference.
   This conference with Division and OCE occurs within 60 days of OCE approval of the Phase I GDM. (The 60 day estimate is unrealistically low in situations where Congressional approval is required.) This conference initiates Phase II of the post authorization process.

TABLE 2-2 (CONT.)

Draft Phase II GDM.
The Phase II GDM is a document concerned with the engineering design details of the structures associated with the project formulated in the Phase I GDM.

9. Division Review and Submission of Phase II GDM.
If changes have occurred since the Phase I GDM, a revised SOF and a fully coordinated revised EIS will also be submitted to the Division.

OCE Approval of Phase II GDM.
OCE approval is required for the Phase II GDM on complex (e.g. dam) projects. Division approval may suffice for less complex projects.

Preparation of Feature Design Memoranda (FDM).
A design memorandum is prepared for each major element of the project. The memoranda are based on the GDM and provide the basis for preparation and approval of plans and specifications.

10. Division and OCE Approval of FDM.
Some FDM can be approved by the Division. The design memoranda for key features must be approved by OCE.

Preparation of Plans and Specifications.

Division Review and Approval of Plans and Specifications.

References: OCE, BERH, Planner Orientation Course, May 1974

OCE, ER 1110-2-1150, Post Authorization Studies.

OCE, ER 18-2-2, Intensive Management Program Monitor System, 1 August 1974.

Adapted from Randolph and Ortolano (1975, p. A-9).

is made of the feasible alternatives presented in the Survey Report in light of current economic and environmental conditions to determine the extent of modification or reformulation of the authorized plan required. The informal information gathering process used is similar to that of the Survey Investigation, involving other agencies and local interests, although the process may be somewhat abbreviated. This information will be used to develop more detail in the design features of the proposed project and to identify areas of concern which may require modifications of the project. The study manager, in collaboration with other organizational elements, then prepares a draft Phase I GDM, outlining the modifications contemplated, which is subject to Division and OCE review and approval.

The only required public meeting of the Phase 1 process occurs after approval of the draft Phase 1 GDM (milestone 4) and after the study manager and other participants, such as local sponsors and environmental specialists, have developed revised project proposals. At this meeting the revised plan is presented and comments are entertained and recorded. The purpose of this meeting is to ensure that the views of interested parties have been adequately addressed and that local support for the project still exists. Information developed at this meeting is then incorporated into the modified plan in preparation for the review conference (milestone 5) with Division and OCE representatives. This conference serves to verify that all relevant information has been considered and that a Phase 1 GDM presenting the modified plan should be finalized. The preparation and submission of the final Phase I GDM to OCE indicates the completion of Phase I of post-authorization planning.

The procedures followed in preparation of EIS's in this process is somewhat more complex than in pre-authorization planning. For projects that were authorized after the passage of NEPA and that had an EIS accompanying the Survey Report a draft revised EIS or draft supplement is prepared and circulated for review prior to the public meeting (milestone 3 of Table 2-2), if required. The final revised EIS is then prepared and submitted with the Phase I GDM. For projects which were authorized prior to NEPA, thus for which no EIS accompanied the Survey Report, a draft EIS is prepared and circulated for review and comment before the public meeting. Typically an environmental specialist has the responsibility to prepare these environmental documents in either case, although where only a revised EIS is required and few changes are contemplated this role may be minimal.

In studies where significant changes in scope, cost, or purpose, among other things, are contemplated, regulations require that a Post Authorization Change Report (PACR) be prepared to accompany the Phase I GDM. This document may be an appendix to the GDM or a report by itself, depending on the magnitude of change, describing the changes which require it and the motivations for those changes. Data on revised project economics and other significant effects are also discussed. Of the studies examined in this research 7 of 14 required the preparation of PACR's for modifications ranging from revised construction methods to complete project reformulations.

The more extensive the modifications undertaken in Phase I planning the more the process appears to resemble the pre-authorization process, with more elaborate public and agency involvement, more environmental field study and more documentation. The study duration is also increased with the scope of change, the studies in this research ranging from 2 to 11 years duration. The submission of the Phase I GDM along with a revised EIS and perhaps a PACR to OCE and, in some cases, the Congress, signals the end of the Phase I process.

In both pre and post-authorization planning the return of reports by higher level review can lead to repetition of earlier steps in the planning process, e.g. public meetings, and may require additional documentation. As a result the descriptions provided above become even more complex. However, the discussion should enable the reader to interpret better the findings of subsequent chapters.

Chapter Three

ELEMENTS OF RESEARCH DESIGN

This chapter presents the conceptual basis of the Corps of Engineers investigation and describes various issues related to the validity and generalizability of research results. As previously mentioned, this investigation is part of a larger effort which also examines public works planning by the U.S. Bureau of Reclamation and the California Department of Transportation. Although the following discussion focuses exclusively on the Corps investigation, the research design discussed herein provided the general framework within which all three agencies were examined.

3.1 Synopsis of the Research Design

This investigation examined the ways in which environmental information is gathered, evaluated and utilized by planners in District offices of the Army Corps of Engineers. It employed a rigorous research design to reach conclusions about the extent to which various factors influence the consideration of environmental information in planning decisions concerning water resources development projects. This research design may be conveniently described using the terminology of statistics. A series of three "dependent variables" was defined to represent the influence of environmental factors in: (1) the formulation of alternative plans, (2) the ranking of alternative plans, and (3) the modification of a tentatively selected plan. Formal *a priori* hypotheses concerning the relationship between these dependent variables and other "independent variables" were formulated on the basis of findings from previous research efforts at Stanford; these were summarized in Section 1.1 above. The "independent variables" were categorized into four variable groups: Organizational Design, Attitudes, External Coordination, and Timing. The research consisted of measuring the dependent and independent variables for a number of Level C planning studies (the unit of analysis) by interviewing study managers and environmental specialists and by examining documentation related to these studies. The data were then used to test the hypothesized relationships between the dependent and independent variables using standard statistical methods.

Key elements in the design of this research are highlighted in the remaining sections of this chapter.

3.2 Population Selection and Sampling

For purposes of this research a "population" was defined as a group of planning studies which are conducted by a given agency and which adhere to specified selection criteria. The agency is, of course, the Corps of Engineers. The selection criteria used to define these populations were suggested in broad terms by the research Oversight Committee* in November of 1976. The committee expressed interest in two "types" of Corps studies: 1) those recent studies that were being planned entirely under the influence of NEPA procedures and which has been also significantly influenced by the P&S guidelines of the WRC and 2) those older studies for which feasibility investigations had generally been completed prior to the implementation of NEPA procedures and for which NEPA and the P&S had influenced only the later stages, i.e. post-authorization planning. Consultation with staff members of OCE led to the adoption of "milestone criteria" (see Tables 2-1 and 2-2) to define more precisely the groups of studies having these desired characteristics. The adopted criterion for the first population, the "recent studies" was:

> Survey Investigations in which the draft Survey Report had been or would be filed with the relevant Division office during calendar years 1975-1977. (This is milestone 7 of Table 2-1.)

Computer printouts of studies in all Divisions (thus Districts) meeting this criterion were made available by OCE staff and the resulting lists of studies verified by personal communications with Division Chiefs of Planning. At the time of sampling there were 117 pre-authorization studies meeting this criterion.

The adopted criterion for the second population, the "older studies", was:

> Post-authorization studies in which the Phase I General Design Memorandum had been or would be filed with the relevant Division office during calendar years 1975-1977. (This is milestone 6 of Table 2-2.)

---

*This committee was made up of representatives of the participating agencies and other groups interested in the consideration of environmental factors in agency planning. Appendix C lists the membership of the committee.

Computer printouts of all such studies provided by OCE were likewise verified by personal communications with Division Chiefs of Planning. At the time of sampling there were 73 post-authorization studies meeting this criterion.

The sampling procedure used to select individual planning studies for analysis aimed initially to provide 15 studies from each of these populations which could be considered "representative" of the populations as a whole. To do this, a list was compiled of the District and Operating Division offices having at least two of each study type meeting the selection criteria. The reason for not considering offices where only one of either study type was underway was to curb data gathering costs since the offices are quite widespread, geographically. This criteria eliminated 19 of the 38 District and Operating Division offices. Thus the populations ultimately sampled consisted of 85 recent studies and 61 older studies.

Of the 19 remaining offices, 7 were chosen at random to participate in the research. In the offices thus selected having more than two studies of each type, random number tables were used to select two studies of each type, i.e., recent and older studies, as members of the sample. This process ultimately resulted in sample sizes of 14 for each type of study from the following Districts: Alaska (Anchorage), Albuquerque, Buffalo, Jacksonville (Fla.), Louisville, Sacramento*, St. Louis and Tulsa. The studies thus selected ranged from small single-purpose levee projects to large multiple purpose dams and reservoirs. The principal project purposes included navigation, flood control, hydropower, beach erosion, bank stabilization, and salinity control. Thus the samples include a wide range of projects from quite diverse geographical regions.

3.3 Pretesting, Data Acquisition and Analysis

The hypotheses formulated in this investigation were selected as a result of research efforts summarized in Section 1.1. Using case studies from agencies engaged in the planning of various kinds of public works, these research efforts had suggested that certain characteristics of water resources planning agencies, such as policies toward the timing and extent of external coordination, seemed to influence the consideration given to environmental factors in project planning. In this research, apparent relationships between the influence of environmental factors in various planning activities (i.e., the dependent variables) and these agency characteristics (i.e., the independent variables) were stated as formal hypotheses; each hypothesis relates each of the three dependent variables to a general type of behavior, attitude or policy. Consider, for example, the following hypothesis:

---

*The eighth District, Sacramento, was included in extensive pretesting and two studies from the District are represented in the samples of 14.

> "The influence of environmental information on the formulation and ranking of alternatives will be increased if the communication behavior of the study manager and the environmental specialist is open, informal and direct.

This hypothesis relates two dependent variables, "influence of environmental information on formulation and ranking of alternatives" to an independent variable "communication behavior". In order to test this hypothesis the general term "communication behavior" had to be defined operationally by specific independent variables (e.g., frequency of verbal communication, proportion of communication initiated by the environmental specialist, etc.) which represent characteristics of "communication behavior." Questions were then formulated to measure the presence or occurrence of these characteristics in a planning study. For example, to measure the frequency of verbal communication, a respondent was asked to indicate on the following scale approximately how often verbal communication occurred between the study manager and the environmental specialist:

a) less than once a month
b) once or twice a month
c) about once a week
d) several times a week
e) every day

In the same manner, each of the other dependent and independent variables was defined in terms of specific questions addressed either to the study manager or the environmental specialist of a planning study; these questions were organized into a standardized interview questionnaire. Appendix A contains a detailed description and definition of each dependent and independent variable, including the questions which were used to measure these variables.

Pretesting

The principal means of data gathering used in this research was the personal interview. The interview relied on a structured questionnaire consisting of open- and closed-ended questions administered by the interviewer and short forms completed by interviewees.* Preliminary versions of the interview were pretested in the San Francisco and Sacramento Districts on studies meeting the population criteria defined above.** Initial pre-testing in San Francisco led to substantial revisions in the questionnaire format to better define questions and response scales. Pre-testing in Sacramento led to some minor revisions, however, the format used was similar enough to that used in subsequent interviews to allow two cases from that District to be included in the final analysis. Pretesting also served to identify the documentation to be used in validating interview responses.

Data Collection

With the assistance of OCE staff, District Chiefs of Planning were contacted and appointments scheduled with relevant study managers and environmental specialists for the planning studies in the samples described above. The interviewer then spent a week at each of the Districts included in the samples obtaining project documents and interviewing.+ Personal interviews with the study manager and environmental specialist for each study took, on the average, one day to complete. Additional time was spent talking with other District personnel knowledgeable about the studies and examining written records which were unavailable for release. Prior to each interview the interviewer prepared a "fact sheet" outlining the planning study based on available documentation. This allowed the interviewer to guide the questioning process, as appropriate, to areas in need of elaboration.* Notes were taken on the interview forms to supplement responses to specific questions and tape recordings were made to ensure that significant information was not overlooked during coding.

---

*Appendix A describes in detail the questions used in the interviews.

**Question statements used in the Guttman attitude scaling exercise (discussed in Chapter 6) were also pretested at an earlier date on a sample of 133 environmental planning and construction management graduate students at Stanford University.

+All interviews were conducted by the senior author of this report.

Data Analysis

The first step in data analysis was the encoding of information from the interview questions onto computer files. This resulted in approximately 1000 numeric values for each case (or planning study), representing the responses to individual questions and items. Procedures for combining these responses into scores for the various dependent and independent variables, as outlined in Appendix A, were instituted later.

It is important to note the level of measurement implied by the numeric values thus encoded. In some instances individual question responses took the form of counts, e.g., the number of planning workshops held during the study, which attain the ratio level of measurement.** Ratio level of measurement implies the real existence of zero values and known interval sizes between values. Thus in a ratio scale 4 is twice as much as 2 and values of 0 do occur "naturally." In other instances, question responses took the form of more qualitative values, e.g., the perceived frequency of verbal communication between study managers and environmental specialists noted above, which attain only the ordinal level of measurement. In this instance a response of "(d) several times a week" (coded as a 4) is known to be greater than "(b) once or twice a month"(coded as a 2) but that is all that can be said. The coded value of 4 cannot be interpreted as meaning twice as much verbal communication as the coded value of 2, all that can be said is that "4" implies a greater frequency of communication than "2". The level of measurement attained by the data determines the types of statistics which can be used. Although some data collected in the interviews attains the ratio level of measurement a sufficiently large portion of it attains only the ordinal scale, and the statistical analysis techniques that were used treated all the data as if it were ordinal.

---

*It should be pointed out that, although a standardized questionnaire was used, many questions of a probing nature were asked which do not appear on the questionnaire.

**For an excellent and succint discussion of levels of measurement see Nie, et al., 1975, pp. 4-6.

In testing hypothesized relationships between dependent and independent variables, it was necessary to select a data analysis technique that would utilize the ordinal property of the variable scores and provide a numerical measure of association (or "correlation") between variables. The correlation statistic which was considered to best satisfy this set of needs was Kendall's Rank Order Correlation Coefficient (see Appendix B for a detailed presentation of this correlation statistic). Kendall's Tau, as it is more commonly known, indicates how closely two sets of ranks "agree," i.e., the extent to which the rank ordering of cases on one set of variable scores matches the rank ordering of cases on another set of variable scores. A correlation of 1.0 indicates complete agreement in the rank orderings of the two sets while a correlation of -1.0 indicates that cases ranked on one set of scores is exactly reversed with respect to the other set of scores. A correlation of 0.0 indicates no association (i.e., the "agreement" of ranks was just as frequent as the "reversal" of ranks).

Some variables examined take on only a small number of values, e.g., responses to yes-no questions. In these instances the rank correlation is not a satisfactory statistic and the analysis was forced to rely on two tests of difference in central tendency, the median test and the Mann-Whitney test. These tests evaluate the difference in dependent variable scores between two groups of cases defined by independent variable scores, such as the yes-no dichotomy noted above,* and determine the probability that the difference is due purely to randomness.

In addition to knowing the strength of association between two variables, or the strength of the differences examined with the median and Mann-Whitney tests, it is desirable to assess the statistical reliability or significance of the observed correlation or difference. In connection with Kendall's Tau, for example, the "level of significance", denoted as p, is determined by comparing the agreement observed in the rank ordering of two sets of scores with the agreement that would be obtained if scores were randomly distributed (Appendix B contains a more rigorous description of level of significance). The level of significance, p, represents the probability of concluding that a correlation or difference is spurious when, in fact, the correlation or difference is statistically meaningful. Thus, the lower the value of p, the greater the probability of correctly concluding that a computed correlation coefficient or difference is statistically significant. For purposes of this research, correlations were considered statistically significant for values of p less than or equal to 0.10. For the sake of consistency, computed correlations are hereafter reported in the following standard notation: $\tau = X.XXXX$ or $p < Y.YY$, where X.XXXX denotes the computed value of Kendall's Correlation Coefficient and Y.YY denotes the level of significance.

---

*A more rigorous discussion of these tests is found in Appendix B.

These statistics, the correlation τ and the two tests of difference in central tendency, are the basic analytic tools employed in the remainder of this report. A further statistic, the partial correlation τ_p, is used in Chapter 9 in exploratory analysis and is discussed there as well as in Appendix B. In the discussion of Chapters 5 through 8 the identification of statistically significant correlations and differences are interpreted in the context of whether or not they support the *a priori* hypotheses.

A data reduction technique used extensively in the analysis is index construction; it involves the process of combining the scores for several different variables. Consider, for example, the case of "communication behavior" mentioned above. In this instance, an index could be constructed from variables representing frequency of verbal communication, relative use of informal communication mechanisms, proportion of communication initiated by the environmental specialist, etc. Ideally, an index like this could be fashioned to represent a composite measure of the extent to which communication behavior on a given planning study was open, informal and direct. If such an ideal could be attained, the index would be suitable for use in testing the *a priori* hypothesis.

In order to use an index to test an hypothesis, it is necessary that the concepts involved in the hypothesis be unidimensional and that the index represent an indicator of this single dimension. This circumstance is difficult to attain for the following reasons: (1) the variables included in the index may not *fully characterize* the dimension reflected in the concept, (2) one or more of the variables in the index may be *unrelated* to the dimension, or (3) the concept may be multi-dimensional, and therefore too general to be characterized unambiguously with a single index. Therefore individual variables contemplated for use in an index must not only characterize, at least on the face of it, some aspect of the dimension of interest, but must also be empirically related to that dimension; thus, the individual variables must be related to each other.* If such a set of variables is found the method by which they are combined depends on the level of measurement they attain. Ratio level measurements may simply be added. Ordinal measurements, such as the 1 to 5 scales used in this research, must be converted to dichotomies before adding since addition requires at least interval levels of measurement and dichotomies can be considered to be interval (Nie, 1975, p. 5). Conversion to dichotomies is accomplished by considering all ordinal values greater than or equal to a "cutpoint value" to be 1's and all ordinal values less than the cutpoint to be 0's. After this conversion any number of ordinal variables may make up an index provided, of course, that they are related and that their combined effect is interpretable.** Another related data reduction technique is scale construction. This is similar to index construction except that an intensity ordering is implied among the variables constituting the scale. This method was used primarily in the measurement of attitudes and is discussed in greater detail in Chapter 6.

Results of the analysis of dependent and independent variables were evaluated by several qualitative methods to provide a basis for explaining analytic results. More specifically, such methods served to: (1) confirm the validity of observed correlation coefficients, (2) isolate particular planning studies which did not conform to _a priori_ hypotheses, and (3) provide insights into how hypotheses might be refined and improved in follow-on research efforts.

---

*The technique used to identify these relationships is item analysis (see e.g., Babbie, 1973, pp. 256-263). It consists of examination of the strength of bivariate correlations between individual variables thought to define the dimension of interest. Variables which do not appear to be correlated with the others being considered are dropped from analysis until a subset is found all of which are strongly correlated with each other.

**As discussed further in Chapter 4, this process of converting ordinal data to dichotomies and then adding is utilized in defining and measuring the dependent variables.

One type of qualitative analysis involved reviewing the descriptive statistics (i.e., median, frequency distribution, etc.) of each dependent and independent variable. This type of analysis made it possible to eliminate from the statistical analysis variables whose scores exhibited little variability; such variables were not useful in the statistical analysis because they provided no basis for comparing planning studies.

Another type of qualitative analysis consisted of reviewing scattergrams* for each of the computed correlations. Scattergrams were used, not only to illustrate the range over which planning studies were distributed, but also to indicate which planning studies did not conform to the hypothesized relationships between variables. These planning studies were then analyzed individually to determine if there were special or unusual conditions present in such studies which could account for their "nonconformance."

Yet another type of qualitative analysis was used to evaluate correlation results. This analysis involved assessing the social and political context within which planning was carried out for each planning study. The rationale for such an analysis was that the effect of independent variables on the consideration of environmental factors may change with various social and political parameters (e.g., extent to which project area is urbanized, intervention of hierarchical or political authorities, changes in Corps regulations during the planning study). Sensitivity to the influence of these parameters was necessary in interpreting correlation results accurately.

3.4 Internal Validity Considerations in the Research Design

A variable is said to represent a "valid measure" if it, in fact, "measures what it purports to measure" (Kaplan, 1964, p. 198). In defining the "internal validity" (viz-à-viz external validity as discussed in Section

---

*In this case, a scattergram is a two-dimensional plot of the scores for a dependent variable against the scores for an independent variable. On a scattergram, each planning study is represented by a point whose coordinates are the dependent and independent variable scores assigned to the planning study.

3.5 below), Webb, et al., (1966, p. 10) observe:*

> Internal validity asks whether a difference exists at all in any given comparison. It asks whether or not an apparent difference can be explained away as some measurement artifact.

The discussion below indicates the precautions taken in this research to obtain valid measurements.

As noted in Section 3.3, the approach taken in this research was to formulate a priori hypotheses concerning the relationships between various dependent and independent variables. These variables were then measured using personal interviews and project-related reports, etc., for each study included in the two Corps samples; data collected in this manner were used to test the formal hypotheses. Thus, the research was designed so that hypotheses were formulated on the basis of previous research efforts and tested on the basis of information collected in the present investigation.

Relationships between the dependent and independent variables were hypothesized in very general terms, i.e., each hypothesis relates each of the dependent variables to a general concept (e.g., type of behavior, attitude, or policy). These concepts had to be defined specifically by independent variables. The selection of these independent variables, which essentially operationalized concepts reflected in the hypotheses, was based on one or more of the following criteria: (1) the apparent accuracy with which the variable appeared, on its face, to measure the concept in question (i.e., "face validity"), (2) the extent to which the same or similar variables had been used to measure this concept in previous research efforts, and (3) the extent to which a variable could be cross checked against written records or other variables reflecting similar characteristics.

A concerted effort was made to choose variables that were based on factual information and whose measurement would be affected neither by the interviewer nor by the conditions under which the interview was conducted. In terms of the validity of the research design, the advantage of selecting variables whose measurement is based on factual information is that such information may be verified by consulting other planners or project-related reports and documents. Reports and documents which provided verification and elaboration of interviewees' responses included: Survey Reports and General Design Memoranda, Environmental Impact Statements (drafts and finals), Plans of Study, public information brochures and booklets, other reports as available and, to a limited extent, study files.

---

*Unfortunately, the term "validity" has been used in a wide variety of ways in the social sciences. For a thorough discussion of many different validity concepts see Phillips (1976) and Kerlinger (1973).

Several efforts were also made to avoid biased responses during personal interviews with Corps planners and environmental specialists. These efforts included the following:

1. Standard references on good interview technique (e.g., Babbie, 1973) were reviewed in preparation for interviews. Special attention was given to the attitudes and conduct of the interviewer, proper introduction of discussion topics, and clarification of interview questions in an unbiased manner.
2. Questions designed for each of the two groups of respondents (i.e., study managers and environmental specialists) were administered in the same phraseology and the same sequence for all planning studies examined.
3. A brief explanation given to each respondent at the outset of the interview indicated that the purpose of the research was to explore the ways in which information was generated and utilized in the planning study; questions making specific reference to environmental information were placed at the end of the questionnaire to avoid undue emphasis on the environmental focus of this research.
4. Most responses were recorded on forms administered directly to the respondent.
5. The statement of questions was close-ended rather than open-ended wherever possible, although comments or qualifications volunteered by the respondent were noted for subsequent consideration.
6. Respondents were continually reminded that all questions (except the question regarding general attitudes toward environmental/economic tradeoffs) were intended to be project-specific, and that their responses were to represent what actually occurred in the planning study instead of what typically occurs in other planning studies.

3.5 External Validity Considerations in the Research Design*

"External validity" refers to the generalizability of research results, i.e., the extent to which conclusions obtained by analyzing a sample of studies may be said to apply to the entire population of studies from which the sample was drawn. This essentially revolves around the questions of bias in sampling procedures and strictness of definition of population characteristics.

The population characteristics used in this investigation are the milestone criteria specified in Section 3.2 above. Thus the populations, strictly speaking, to which inference should be made are all those studies which satisfy these milestone criteria, and no more. It would be of interest to be able to generalize the findings of the research to all Corps level C planning. However, given the rate of change in regulations governing the planning process and the fact that there is a "learning process" by which existing regulations and guidance become more effectively implemented over time suggests that such generalization would be tenuous. As a result, inference can comfortably be made only to planning studies meeting the milestone criteria, thus providing a "snapshot" of a larger evolving process.

The extent of bias introduced into the sampling process used in this investigation is partly a function of the degree to which planning carried out by the 19 Districts sampled, where 2 or more of each type of study were underway, differs from that carried out in the remaining Districts having fewer than 2 of one of the study types underway. Such differences could be substantial if the levels of planning activity in the unsampled Districts were chronically lower than that of the sampled Districts. The fact that the 19 sampled Districts account for 73% of the pre-authorization studies and 84% of the post-authorization studies suggests that this difference in activity level may be long-term. The effects that this lower activity level would have on the variables used in the investigation is not known, but if significant it would force an additional qualifier onto the population criteria limiting findings to those studies undertaken by "high activity" Districts.

---

*External validity of survey research designs is discussed extensively in the literature (e.g., Babbie (1973), Michelson (1975)).

Another possible source of bias could be geographical. Some regions of the country may have a generally higher level of environmental awareness or interest among the populace than others, which would presumably be reflected in the conduct of planning studies in those regions as well as the political influences initiating those studies. Given the small number of Districts actually visited, a random sampling procedure does not provide insurance against this bias.

The reader should bear these issues in mind when interpreting the results discussed in subsequent chapters. Although the effects of these biases are not fully known, they are not expected to be great; notwithstanding these difficulties, it is felt that the findings presented herein still provide many useful insights into the factors associated with the increased influence of environmental factors in planning.

Chapter Four

ENVIRONMENTAL FACTORS IN CORPS DECISION-MAKING: THE DEPENDENT VARIABLES

This chapter discusses the methods of measurement used to describe the influence of environmental information on the formulation and ranking of alternative plans and on the modification of a proposed plan, i.e., the three "dependent variables" described in the research design discussion of Section 3.1. The chapter first discusses what is meant by the term "environmental" and the presents the rationale underlying the measurement of each dependent variable. Methodology of scoring, descriptive statistics, and interpretations of the meaning of the variables round out the discussion of each dependent variable.

4.1 "Environmental" Considerations and Corps Civil Works Planning

The intent of the National Environmental Policy Act of 1969 (NEPA) was to encourage federal agency planners to consider the quality of the human environment in making decisions concerning, among other things, the planning, design and construction of public works projects. In preparing an assessment and evaluation of a project's anticipated impacts, planners were obliged to consider social, cultural, and natural environmental factors, as well as economic and engineering factors, in the development of public works projects. Such consideration is required both for projects planned by federal agencies and for projects planned by other government agencies with the financial support of the federal government. The measurement of the dependent variables used in this research represents an attempt to capture the degree of this consideration present in plan formulation, plan ranking, and plan modification decisions.

The first step in devising an "objective" method of assessing the degree of environmental consideration present in decision-making is definition of what is "environmental". Extensive judicial interpretation of NEPA has led most observers to adopt broad definitions of the term (Anderson, 1974). Dictionaries allude to the totality of one's surroundings. Clearly a more precise definition is required for the purpose at hand. A first step in arriving at a working definition was to consider as "environmental" all factors other than the traditional technical and economic considerations used in planning prior to NEPA. Based on this broad dichotomy a list of issues was devised where certain issues were considered "environmental" and others "non-environmental". This listing, which is thought to encompass the range of considerations encountered in Corps Civil Works planning, was refined until it could be used as a guide. Table 4-1 presents this listing of issues. In scoring the dependent variables (and some of the independent variables) this guideline was consulted whenever the interpretation of a planning situation was ambiguous. Thus for the purposes of the research, "environmental" is defined by the guidelines in Table 4-1. More detailed discussion of variable definitions and scoring procedures are presented in Appendix A.

4.2 Formulation Variable

Modern decision theory* describes formulation of alternatives as the creative process of defining a variety of means through which the achievement of some desired end(s) may be accomplished. This decision model, which provides the theoretical basis for the measurement of the formulation variable, requires that goals and alternatives be explicitly defined. The extent of consideration given environmental factors in this formulation process are, for the purposes of this research, assumed to be reflected in 1) the extent to which they represent environmental goals to be achieved and 2) the extent of achievement of those environmental goals provided by the alternatives being considered.

Goals, in the positive sense, can represent the achievement of some desireable end state and, in the negative sense, can represent the avoidance of some undesireable end state. Often the distinction between these two views is blurred, particularly when one discusses environmental impacts. For example, habitat preservation can be viewed as a "positive" goal (or an objective) and avoidance of habitat destruction can be viewed as a "negative" goal (or a constraint). In order to ascertain whether environmental factors had represented goals in each pre-authorization study sampled, study managers were asked to define the planning objectives and planning constraints

---

*See, e.g., Matheson and Howard, 1968.

TABLE 4-1

GUIDELINES FOR CLASSIFICATION OF FACTORS AS BEING "ENVIRONMENTAL"

Factors to be considered "environmental" consist of project effects on:

- Air and water quality
- Natural ecosystems and habitats
- Land use patterns and open space
- Existing community and social relationships
- Preservation of cultural or historic resources
- Preservation of unique natural areas
- Aesthetics, landscaping and visual impacts.

Factors to be considered "non-environmental" consist of project effects relating to:

- Project economic feasibility, cost considerations and financial support
- Technical design considerations (e.g., site geology or levels of service)
- Political acceptability of the proposed project
- Primary project outputs which have traditionally been provided (e.g., flood damage reduction)
- Use of traditional project outputs (e.g., flat water recreation).

---

which had guided and influenced the formulation process in their studies. Examples of objectives (given by the interviewer as a guide) were flood control and fish and wildlife enhancement. Examples of constraints given were economic feasibility requirements and habitat destruction. It was felt that if specific environmental issues had been truly salient in this stage of planning, they would be mentioned as either a planning objective or a planning constraint. Table 4-2 lists a representative sampling of the objectives and constraints described by study managers.

The objectives and constraints thus defined were corroborated by information in planning documents and then entered across the top of one

TABLE 4-2

PLANNING OBJECTIVES AND CONSTRAINTS

"Environmental" Objectives and Constraints:

- Avoid encroachment on park land
- Preserve blackbird nesting area
- Preserve existing riparian habitat
- Maintain downstream water quality and thermal regimes
- Minimize alteration of circulation patterns in harbor to preserve marine habitat
- Avoid disruption of archeological site
- Preserve unique reef area
- Enhance "green space" with detention basins
- Avoid unique area of virgin forest
- Avoid export of water from basin

"Non-Environmental" Objectives and Constraints:

- Provide municipal water supply
- Comply with basin water rights compact
- Accommodate unique hydrologic character of basin
- Accommodate sediment characteristics of river
- Achieve economic feasibility
- Provide flat water recreation facilities
- Achieve compatibility with existing harbor facilities
- Accommodate political factionalism among locals
- Accommodate local desires for immediate improvement
- Improve local navigation safety

of two matrices similar to Figure 4-1. Only objectives and constraints which could be specifically described and which were supported by documentary evidence were entered in these matrices.

The alternatives considered in Corps pre-authorization planning studies typically evolve from very general concepts to fairly specific project proposals. Along the way old ideas are discarded, new ideas

FIGURE 4-1

FORMULATION MATRIX EXAMPLE

Please indicate the extent to which the alternative plans achieve the planning objective (constraints influenced the alternative plans).

No Achievement (Influence)	Limited Achievement (Influence)	Moderate Achievement (Influence)	Large Achievement (Influence)	Maximum Possible Achievement (Influence)
1	2	3	4	5

	Planning Objectives (Constraints)							
Alternatives Given Detailed Study	Objective or Constraint #1	Objective or Constraint #2	Objective or Constraint #3	Objective or Constraint #4	Objective or Constraint #5			
Alternative A								
Alternative B								
Alternative C								
Alternative D								

added and some ideas combined with others to produce hybrid alternatives. Thus, over the course of a study, a great many "different" alternatives may be considered. In order to reduce this to some tractable number and to eliminate from study those alternatives which did not receive serious consideration, a series of interview questions asked study managers to describe the "screening" processes used to narrow the field of choice. This resulted in the identification of those specific proposals that study managers felt had received "detailed study". In some cases these alternatives represented variations of a single concept while in others a greater variety of features resulted. In only one case, however, was a non-structural alternative viewed seriously as a potential recommendation,* and in that case no regional authority would come forward to sponsor such an alternative and a Negative Report resulted.

This narrowed field of alternatives was verified by reference to planning documents and then entered along the left side of each of the two matrices similar to Figure 4-1. Across the top of one matrix were the planning objectives previously described and across the top of the other were the planning constraints. Study managers were then given the two matrices and asked to indicate on a scale from 1 (none) to 5 (highest possible) the degree to which each alternative achieved each objective listed and the degree to which each alternative had been influenced by each constraint listed.** This resulted in all the information necessary to score the formulation variable.

Scoring and Interpretation

The first step in scoring the formulation matrices was conversion of each 5 point ordinal scale to a 0,1 dichotomy. All scores of 3 through 5 were thus converted to 1's and scores of 1 or 2 were converted to 0's.* Next each objective and constraint was categorized as environmental or non-environmental using the guidelines of Table 4-1. Scores for each objective and constraint were then summed vertically. To obtain the final score used in subsequent analysis the total scores of "environmental" objectives and constraints were divided by the total scores for all objectives and constraints producing a ratio between 0 and 1 from each matrix. When added these ratios produced the score used to indicate the influence of environmental information on plan formulation.

---

*The Corps may recommend that no Federal action be undertaken but has only advisory authority with regard to implementation of non-structural measures.

**The process of developing and scoring these matrices usually took from one to three hours.

The scores thus produced ranged from 0 to 1.46 (the maximum possible score was 2) with a theoretical median of 0.38. No ties resulted and the rank order of studies thus produced agreed quite well with the overall impressions of the interviewer. The score is interpreted in subsequent analyses as expressing the relative influence of environmental factors vis-à-vis all factors salient in the formulation process.

When interpreting the meaning of the scores resulting from this procedure it should be remembered that only specifically worded objectives and constraints were utilized. General responses, such as "avoid adverse impact" or "promote environmental quality", were not scored unless further questioning showed the concern to be based on specifically identifiable problems or needs. Likewise responses referring to the Water Resources Council's two national objectives of National Economic Development (NED) and Environmental Quality (EQ) were not used unless they could be more operationally defined by study managers. This seemingly stringent measure was necessary to eliminate pro forma responses from the scoring process. Thus the formulation variable score indicates the relative influence of specific environmental information unique to each study.

Since the scoring of the formulation variable was accomplished near the end of the studies examined, the judgments contained therein are thought to reflect a synthesis or overview of the formulation process. The influences of particular factors are not recorded unless their significance left a sufficiently lasting impression with the study manager. While this may reflect better the long-term (with regard to the planning study) significance of environmental information, it does not describe the dynamics of that influence during earlier stages of study. The formulation variable score should be interpreted as a "snap-shot" of the final outcome of the planning process, reflecting chiefly the more significant factors influencing the formulation process. It gives no information about the general level of consideration given environmental factors or the changes in influence of environmental factors over the course of individual studies. It should also be noted that the objectives and constraints used in scoring the formulation variable do not reflect secondary environmental issues but only direct impacts. Thus the score reflects the perceived influence of only the direct and specific environmental issues relevant to the study.

---

*This was necessary so that scores for different alternatives could be added while maintaining proper levels of measurement. See Nie et al. (1975, p. 4-7) or refer to Section 3.3,

4.3 Ranking Variable

The ranking of alternatives in multi-objective planning is essentially the process of comparing their relative merits against particular goals or attributes of interest for the purpose of selecting the most desireable alternative. The overall desirability of any given alternative is thus a function of its performance vis-à-vis the individual attributes considered and the relative importance of those attributes. While the formulation variable seeks to discern the performance of alternatives in terms of the attributes of importance (i.e., planning objectives and planning constraints), the ranking variable seeks to discern the relative importance of the attributes themselves. The influence of environmental information on the ranking of alternatives is thus taken to mean the relative importance of environmental considerations vis-à-vis other considerations in the decision to recommend a specific proposal.

To provide a numerical measure of this importance a series of interview questions asked study managers to describe the process by which general consensus regarding the tentative selection of a proposal was reached, and when a final recommendation had been decided upon. At the end of this series of questions study managers were given a list of factors, reproduced in Figure 4-2, and asked to indicate the relative importance they felt each factor had had in the process of deciding on the selected plan. The list

Figure 4-2

FACTORS INFLUENCING SELECTION OF PLAN

Please indicate the degree to which each factor influenced the choice of the selected plan.

Factors Influencing Choice of Plan	Degree of Influence				
	None	Limited	Moderate	Large	Most Dominant
1. Acceptability to the local sponsor.	1	2	3	4	5
2. Economic efficiency.	1	2	3	4	5
3. Extent to which problems and needs are satisfied.	1	2	3	4	5
4. Balance of capital and recurrent cost.	1	2	3	4	5
5. Availability of water.	1	2	3	4	5
*6. Cultural or social impacts.	1	2	3	4	5
7. Acceptability to Congress.	1	2	3	4	5
*8. Environmental benefits.	1	2	3	4	5
*9. Water quality effects or standards.	1	2	3	4	5
10. Acceptability to other agencies.	1	2	3	4	5
*11. Historical/Archeological considerations.	1	2	3	4	5
*12. Air quality effects or standards.	1	2	3	4	5
*13. Fish or wildlife impacts.	1	2	3	4	5
14. Acceptability to the Division or OCE.	1	2	3	4	5
*15. Land use impacts.	1	2	3	4	5
*16. Other (environmental)					
17. Other (non-environmental)					

---

*Factors considered "environmental".

was developed during pretesting and, although study managers were asked to indicate any additional salient factors which were not included, few did so. This provided all the necessary information to score the ranking variable.

Scoring and Interpretation

The first step in scoring the ranking variable was conversion of all values indicated on Figure 4-2 of 3 or greater to 1's and all values of 2 or less to 0's. The resulting scores were summed to obtain the total number of factors having at least a "moderate" influence in the selection decision. Next the scores for the environmental factors (those noted by asterisks in Figure 4-2) were summed to obtain the total number of environmental factors having at least a "moderate" influence on the selection decision. The final score for the ranking variable was then the result of dividing the score for environmental factors by the score for all factors. Technically, then, the ranking score represents the proportion of factors at least moderately influential in the selection decision that were "environmental" factors.

The scores resulting from this process ranged from 0.17 to 0.55 with a theoretical median of 0.41. Unfortunately about half the studies clustered rather tightly around the median making subjective evaluation of their rank orders more difficult. Indeed, when subjective impressions gained from the case study interviews as a group were applied to the rank ordering resulting from actual scores, the extent of agreement between intuition and analytic result was disappointingly low.

In an effort to explain this a more extensive qualitative analysis was done of the ranking process. This analysis revealed that the actual process of selecting an alternative was highly complex and did not agree well with the simple decision model implied by the measurement procedure used. The actual ranking process often appears to be influenced by one or more of the following four substantially different conditions. The ranking can be imposed from above when specific outcomes are strongly favored by the Corps hierarchy (e.g., OCE) or Congress, it can be left nearly entirely to local interests, it can be greatly influenced by pressures from other federal agencies, or it can be significantly determined by planners views of "what is best". All these influences are subject, of course, to the basic requirements of economic feasibility and consensus between the Corps and local sponsors. Only when the conditions described above are not overriding considerations does the selection decision approach the simple decision model supposed by the measure used.

Furthermore, extremely high correlations between the ranking measure and certain independent variable scores suggests that the measure is highly subject to "yeasaying"* and its internal validity is doubtful. Because of these problems, the ranking variable was dropped from the analyses presented below.** The formulation variable is felt to represent a comprehensive measure of the influence of environmental information on the entire plan formulation process, a "summary statistic" of the role played by environmental factors in the Survey Investigation. Intuition suggests that the formulation variable gives an indication of ranking in any case, since the objectives and constraints described represent the attributes of concern in each study.

4.4 Modification Variable

Phase I planning studies represent a reanalysis of the findings and recommendations of Survey Investigations to determine whether circumstances differ sufficiently from those of the feasibility study to warrant significant re-design. Typically the Phase I planning process also aims to better define project design features before construction plans are prepared. Recall that a recommended and Congressionally authorized plan exists at the outset of such studies. The salient features of these studies are the changes made to the authorized plan in response to information obtained in the post-authorization planning process. For the purposes of this research, concern is with the extent to which these changes or modifications are brought about by environmental considerations and the extent to which they alleviate adverse environmental effects associated with the Congressionally authorized proposals.

---

*An old bugaboo in survey research, "yeasaying" describes the provision of responses which reflect what the interviewee thinks the interviewer will interpret as a "good answer".

**Although the ranking variable was a part of the *a priori* hypotheses contained in the original research design, it is not mentioned in the discussion below as a matter of convenience.

A series of interview questions asked study managers to describe the major and minor differences between the authorized plan and the project proposal "as presently envisioned" for their respective studies. The events leading to these modifications were discussed and study managers were asked if any of the changes contemplated were sufficiently great to warrant submission of a Post Authorization Change Report (PACR).* Table 4-3 gives a representative listing of the many types of modifications that were described. All modifications thus described were verified by reference to PACR's or other project reports. It is important to note that in none of the studies examined was the recommendation of "no Federal action" considered a feasible modification. Each of the modifications permitted the authorized plan or some version of it to proceed on to the construction planning stage.

The modifications thus described were then listed across the top of a form similar to Figure 4-3. Study managers were asked to read through the list of factors motivating the changes (see the left side of Figure 4-3) and add any other important factors which were not listed. They were then asked to indicate, on a scale from 1 (no influence) to 5 (dominant influence), the extent to which they felt each project modification had been motivated by each of the factors listed on the form.

In another series of questions study managers were asked to describe the adverse environmental effects, if any, associated with the Congressionally authorized plan. They were then asked to indicate, on a scale from 1 (no change) to 5 (completely avoided), the extent to which they felt the project modifications discussed had alleviated each of the adverse effects previously described. The information resulting from these two lines of questioning provided the data necessary to score the modification variable.

Scoring and Interpretation

The first step in scoring the modification variable was the sorting of the studies into two groups, one where Post-Authorization Change Reports

---

*This requirement is discussed in Chapter 2, Section 4.

Table 4-3

PLAN MODIFICATIONS IN RESPONSE TO ENVIRONMENTAL CONSIDERATIONS

- -Moved damsite 3 miles*
- -Changes in levee alignment
- -Purchase of wetlands*
- -Elimination of channel enlargements*
- -Consolidation of brine storage facilities
- -Switch from shore connected to unconnected breakwaters
- -Change from dam/reservoir to local protection concept for flood control*
- -Alter construction methods to eliminate blasting
- -Establishment of habitat "corridors" through project improvements
- -Relocate borrow areas
- -Dispose of polluted dredge spoils on land rather than in water
- -Add low flow augmentation

---

*Required Post Authorization Change Report

(PACR's) were required and the other where they were not. To the extent that modifications requiring PACR's represented changes that were motivated by environmental considerations, the projects in the PACR group should receive a higher score on the modification variable than other projects (i.e., those that did not require PACR's). The rationale for this is that the modifications requiring PACR's are generally so substantial that it would be inappropriate to rank a study whose modifications (1) required a PACR and (2) were motivated by environmental concerns, below a study that did not have these two characteristics. The following additional step was required to complete this grouping process. For the studies in the PACR group, the text of the Change Reports were examined to determine which modifications required the Change Report and what the motivation was for making these modifications. In cases in which environmental

Figure 4-3

MODIFICATIONS TO AUTHORIZED PLAN

Please indicate the degree of influence the factors have had in producing each of the modifications indicated.

No Influence	Small Influence	Moderate Influence	Large Influence	Most Influential Factor
1	2	3	4	5

Project Modifications

Factors Producing Change	Modification #1	Modification #2	Modification #3	Modification #4	Modification #5			
Increased detail of study								
Changing economic conditions								
New engineering problems								
Local opposition								
Agency opposition								
Changing planning regulations								
Air/Water quality standards								
Adverse social impacts								
Adverse environmental impacts								
Congressional interest								

concerns (i.e., air/water quality, social impacts, or environmental impacts) were not the motivations, the projects were reclassified to the non-PACR group. As in the scoring of the other dependent variables, all of the ordinal 1 to 5 scales were then converted to 0,1 dichotomies using a cutpoint of 3. In terms of Figure 4-3 this meant that 1's represent at least a "moderate" influence, while with regard to the responses concerning impact alleviation, 1's represent at least "moderate" alleviation.

After grouping the studies as PACR and non-PACR and after converting scores to 0,1 dichotomies, the following computations were performed for each study. For the data in the form corresponding to Figure 4-3, the total number of 1's scored by air/water quality, social, and environmental impacts (as factors producing change) were divided by the total number of 1's in the matrix. To interpret this ratio, suppose there was only one modification involved. In this case, the ratio represents the proportion of all factors having at least a moderate influence on producing the modifications that were environmental factors. A similar interpretation holds if there is more than one modification on a study; in this case the ratio can be thought of as the above proportion for the "average" modification.

The next step in the scoring involved examining the responses for the questions concerning the extent to which the project modifications were felt to alleviate the adverse effects. To do this, the adverse impacts described were examined and subjectively classified as long-term or short-term. The short-term impacts were deleted from the lists on the assumption that they were not of sufficient concern in the research inasmuch as they reflected only impacts associated with project construction. The total number of 1's (representing moderate alleviation) listed were then divided by the total number of long-term impacts listed to produce a ratio describing the proportion of long-term impacts moderately alleviated by the modifications considered.

Thus for each group of studies (PACR and non-PACR) two ratios resulted, the first reflecting the extent to which environmental considerations caused the modifications and the second reflecting the extent to which the effects of the modifications alleviated adverse environmental impacts. For each group, these two ratios were then added and the studies rank-ordered within the groups. A constant (1.0) was then added to the resulting PACR group scores to ensure that its lowest ranking member would, in the overall analysis, attain a higher rank order than the highest ranking member of the non-PACR group. This completed the scoring procedure for the modification variable.

The scores resulting from this procedure ranged from 0 to 2.4 (maximum possible score of 3) with a theoretical median of 0.67. No ties resulted and agreement between the rank order thus produced and the subjective ordering of the interviewer was extraordinarily high. The scoring procedure used is quite complicated and a clear definition of the meaning of the resulting number is difficult. In any case a ranking is all that is desired. A more casual interpretation of the modification variable is that it reflects the extent to which environmental considerations led to project changes which actually enhanced environmental quality. It should be remembered, however, that the variable only reflects change; no indication is given as to whether or not the Congressionally authorized plans present at the outset of the studies were "environmentally sensitive". Studies where no changes were made and in which no significant adverse environmental effects could be described received low scores in this procedure for scoring. Some would consider this a bias against pre-authorization planning which adequately addresses environmental considerations. While this may be true in general, the interviews and the examination of project documentation indicate that this was not the situation for the post-authorization case studies included in this research. There did not appear to be any studies receiving low modification variable scores in which the low score could be attributed to any notable incorporation of environmental factors during pre-authorization planning.

Chapter Five

ORGANIZATIONAL CLIMATE:
ELEMENTS OF INTERNAL STRUCTURE AND PROCESS

This chapter discusses a number of concepts which characterize the structure and internal processes of planning activity in Corps District offices and their relationships to the influence that environmental information has on the formulation and ranking of alternative plans and on the modification of proposed plans. These concepts encompass formal organizational design, communication behavior, conflict resolution, and role perceptions. Although some of the variables discussed in this chapter relate to the District office as an entity, it is important to bear in mind that the unit of analysis is not the organization or office *per se* but the planning study carried out within that office.

5.1 Formal Organizational Design

The *a priori* hypothesis regarding formal organizational design is as follows:

> "The influence of environmental information on the formulation of alternative plans, and on the modification of a proposed plan, will be increased if the formal organizational design lends greater authority to the environmental specialist."

In his case studies involving two Corps District offices in California, Randolph (1976) found that in the District where the environmental resources (ER) unit had status as a branch separate from the planning branch in the organizational hierarchy, environmental specialists appeared to exert a greater influence in forcing the consideration of environmental factors than in the District where the ER unit was only a section within the planning branch. This observation, which led to the *a priori* hypothesis above, suggests that ER units having greater authority in terms of their organizational status and formal responsibilities may be more effective in enhancing the consideration given environmental factors in planning. The term "formal organizational design" used in the hypothesis refers to the hierarchical structure and codified procedures which govern the operation of Corps District Offices. These structures or procedures lend authority to the ER unit by defining its *position* and *relative size* in the organizational hierarchy and by formally defining the responsibilities of environmental specialists in the planning of water resources projects. In order to test the rather general hypothesis noted above it is necessary to more carefully define what is meant by position, relative size, and responsibility and to indicate the ways in which "increases" in these factors translate into greater authority for environmental specialists.

Components of Analysis*

As part of the field interviews undertaken as part of this research, a District Statement of Functions was obtained in each District office visited. The Statement of Functions is a written document which includes organizational charts and descriptions of the tasks to be performed by the various organizational units within the District. Examination of the organizational charts of each District allowed comparison of the relative positions, in the hierarchy, of the ER unit and the organizational element responsible for the planning function (hereinafter referred to as the "planning unit"). The planning unit was chosen for comparison since the principal concern herein lies in the integration of environmental considerations into the planning process.

In six of the eight District offices visited for the field interviews, the ER unit was a section within a planning branch which was in turn, an element of an engineering division. In these six Districts, the planning branch also included a varying number of other sections, some specific to certain large studies and others defined by river basins or functions (such as hydrology or economics). In one of the remaining two Districts, the ER unit was a branch within a planning division. This District was different from the six mentioned above inasmuch as the planning function was elevated to division status on an equal hierarchical level with the engineering division. In the remaining District the ER unit was a branch in the engineering division, separate from but at the same level as the planning branch, which was also in the engineering division. Thus it could be argued that in the latter two cases the ER unit has somewhat greater status, in terms of its position relative to the planning unit, in the organizational hierarchy of the District. Assuming that this increased status is a measure of greater formal authority, the a priori hypothesis would be supported if the dependent variable scores were found to be higher for the studies conducted in the last two Districts described above.

---

*For a description of the actual interview questions used and an example of score computation refer to Appendix A, Section 2.

Another aspect of formal organizational design that was examined in the research concerns the relative sizes of the ER unit and planning unit. Size here refers to the number of professionals employed in each unit (i.e., ER and planning) averaged over the duration of the particular planning study. These numbers were provided by the study managers and environmental specialists interviewed. The relative sizes of the two units were computed for each study included in the field interviews; this was done by dividing the size of the ER unit by the size of the planning unit. The resulting ratio varies somewhat within Districts because the planning studies were of different durations. Table 5-1 provides general information on this size ratio for the two populations of planning studies. If increased size of the ER unit relative to the planning unit reflects greater authority on the part of the ER unit, the a priori hypothesis would be supported by positive associations between the size ratio and the dependent variables.

TABLE 5-1

RATIO OF SIZES OF ER AND PLANNING UNITS

	Newer Studies	Older Studies
Mean	.23	.28
Range	.11-.40	.11-.53

The third aspect* of formal organizational design examined as part of this research concerns the formally defined responsibilities of environmental specialists in the planning process. For each of the Districts participating in the interviews the District Statement of Functions was examined to ascertain the formal responsibilities of the ER unit described therein. These formally defined duties were analyzed to determine the presence of mandates for six specific tasks; problem definition, setting of study objectives, formulation of project alternatives, assessment of consequences of alternatives, evaluation and ranking of alternatives, and coordination with outside interests (e.g., other agencies, interest groups, and the public). Furthermore, each mandate was examined to determine whether or not it explicitly went beyond environmental quality (EQ) matters and required participation by the ER unit in the general conduct of the task (e.g., the ER unit might be instructed to prepare EQ plans or, if its responsibilities were broadly defined, it might be instructed to participate in the formulation of all project alternatives). These formally defined responsibilities were then scored in the following manner: if the specific task was not mandated in the statement of functions a score of "0" was assigned; if the task was indicated but there was no explicit mandate to go beyond EQ matters a score of "1" was assigned; if the task was indicated and explicit mention was made of application to non-EQ matters a score of "2" was assigned. Since little variance was found in the scores thus assigned for the tasks relating to problem definition, setting of study objectives, or the assessment of consequences of alternatives, these tasks were dropped from further analysis except for inclusion in an overall index taken as the sum of the scores given for all six tasks. If more broadly defined responsibilities of environmental specialists can be assumed to reflect their greater authority vis-à-vis the formal organizational design, then the _a priori_ hypothesis would be supported by positive associations between the dependent variables and the scores given to the formally defined responsibilities described above.

---

*A fourth aspect of formal organizational design examined concerned the relative GS levels of study managers and environmental specialists. It was postulated that if environmental specialists had higher GS ratings (which reflect education and length of service) relative to study managers, higher scores would be found on the dependent variables. However, a lack of variance in the GS ratings obtained resulted in these variables being dropped from further analysis.

Results of Analysis

With regard to the _position_ of the ER unit relative to the planning unit in the District office heirarchy, the data simply do not support the _a priori_ hypothesis. No significant differences in the scores of the dependent variables were found when they were analyzed in terms of the different organizational types. It is possible, of course, that this is a result of a lack of variance in the independent variable since six of the eight Districts had the same organizational arrangements. However, remarks made during the course of the interviews and some concepts from the contingency theory of organizations provide a better explanation.*

Contingency theorists assert that a key characteristic of the nature of the tasks carried out by organizations is the degree of task _interdependence_ exhibited by those tasks (Thompson, 1967). The lowest form of task interdependence between two organizational units is _pooled interdependence_; in this instance the tasks performed by the two units make discrete independent contributions to the output of the organization. The next level of interdependence is _sequential interdependence_, where the output of one unit becomes the input to another. The highest form of interdependence between two units is _reciprocal interdependence_, where the outputs from one unit become inputs to the other and vice versa. Jenkins and Ortolano (1978) present case study data showing that when environmental specialists function in a planning or design role, they exhibit recriprocal task interdependence with the planning or design units. They also observe, referring to Thompson's work, that the higher the degree of task interdependence the more closely the tasks must be coordinated. They then suggest that, because of the high degree of interdependence between the two units when environmental specialists function in a planning role, the most effective coordination between units would be achieved by placing the ER unit within the planning unit.**

Remarks made by several planners and environmental specialists in the District where the ER unit was a separate branch support this conclusion. They described difficulties in coordination between planners and environmental specialists and suggested that these difficulties were, to a large degree, due to the separation of planners and environmental specialists into separate organizational units. Another criticism of these organizational arrangements was that separate branch status resulted in environmental specialists playing more of a "devil's advocate" role which caused unnecessary delays. While there is surely a need for the objective environmental review of project planning connoted by the "devil's advocate" role, the planning process may be more effective when ER units are an integral part of planning units.

---

*Contingency theory asserts that effective task performance is facilitated by organizational arrangements which are contingent upon the nature of the task being performed; Jenkins (1977) has elaborated on the extent to which this theory might be relevant to the design of organizations that carry out water resources planning.

**In applying contingency theory to water resources planning, Jenkins and Ortolano conclude that the "best" organizational location for environmental specialists is contingent upon the roles to be emphasized, a conclusion which is in agreement with the central postulate of contingency theory.

With regard to the size of the ER unit relative to the planning unit, significant correlations were found supporting the a priori hypothesis. The size ratio showed significant positive correlations with both the formulation variable ($p < .05$) and the modification variable ($p < .10$). These correlations should not be construed as implying that having a larger environmental staff causes a greater consideration of environmental factors in planning. Rather, the correlation should be interpreted as being a reflection of a general committment on the part of some Districts to devote more resources to environmental planning. Qualitative impressions gained through the process of conducting the field interviews support this interpretation. These interviews revealed a notable difference between Districts in terms of the extent to which the office hierarchy (i.e., District Engineers and chiefs of divisions and branches) seemed to provide leadership and support for the consideration of environmental factors in planning. Indeed, several interviewees made a point of indicating that the interview questions did not give adequate attention to the role of the District hierarchy in decision-making. In one District, a study manager attributed the low priority given to environmental and social aspects of the project to the office hierarchy, while in another the high priority given to environmental and social issues was also attributed to upper level management. Moreover, nearly half of the environmental specialists who felt that environmental issues had not been adequately addressed in the studies included in this research cited resource constraints as the primary barrier. Taken together, the size ratio data and these qualitative impressions suggest that the consideration given to environmental issues in plan formulation and modification springs in part from a perception on the part of planners that such consideration is deemed important by their superiors and will be supported by adequate resources.

With regard to the formally defined responsibilities of the environmental specialists the results of the statistical analysis lend some support to the *a priori* hypothesis. The scores for the formulation variable were found to be significantly higher ($p < .05$), using the median test, where the formally defined responsibilities of environmental specialists mandated participation in the formulation of alternatives. Formulation variable scores were also substantially higher where these responsibilities mandated the evaluation and ranking of alternatives and coordination with outside interests but these differences were significant only at $p = .13$. The formulation variable was also found to be significantly correlated ($p < .10$) with the overall index* of formal responsibilities. These findings support the *a priori* hypothesis with regard to the formulation of alternatives, however, no support was found for the hypothesis with regard to the modification of proposed plans. The findings noted above should not be construed as implying causality but should be viewed as another indication of an upper-level management commitment to the integration of environmental specialists into the planning process since, by and large, these formal definitions of responsibilities are written by members of the office hierarchy and approved by the District Engineer.

When viewed in this way, the above relationships support the previously discussed notion of management commitment based on the relative sizes of ER and planning units.** To see if the two concepts were related an analysis was done to determine whether the size ratio previously discussed was larger in offices having more broadly defined responsibilities for the ER unit. In the sample of recent studies, where the formulation dependent variable was measured, the size ratio was at least 16% greater where any one of the three tasks, i.e., formulation of alternatives, evaluation and ranking of alternatives, and coordination with outside interests, was mandated and was 33% greater (significant at $p < .10$ using the median test) where participation in the formulation of alternatives task was mandated. These relationships appear to confirm the importance of the leadership of upper level management within the District as a factor that is closely related to the increased influence of environmental information on plan formulation.

---

*Recall that this index was taken as the sum of the scores given for each of the six specific tasks for the presence of which the formally defined responsibilities were examined.

**An alternative interpretation is that if environmental specialists do not have what they perceive to be a formal mandate to undertake a broader function in the planning process, they will be less inclined to bring environmental values to the attention of other planners.

5.2 Communication Behavior

The *a priori* hypothesis regarding communication behavior is as follows:

> "The influence of environmental information on the formulation of alternative plans, and on the modification of a proposed plan, will be increased if the communication behavior of the study manager and environmental specialist encourages the transfer of information between the two."

In this research communication behavior is investigated in two ways, through identification of the mechanisms of communication and their relative amount of use and by examining the characteristics of communication between study managers and environmental specialists.

Thompson (1967, p. 56) argues that the nature of task interdependence* between organizational units determines the coordination mechanisms most appropriate for communication between those units. Where task interdependence is low (e.g., pooled interdependence), more routinized communication mechanisms, called *coordination by standardization*, are appropriate. Where tasks are sequentially interdependent, referral through superiors or *coordination by planning* is appropriate. Where task interdependence is higher (e.g., reciprocal interdependence) Thompson asserts that *coordination by mutual adjustment*, the reliance on more direct, informal communication, is appropriate. Jenkins (1977) found, in an organizational study of water resources agencies, that an increased reliance on coordination by mutual adjustment was associated with the organization having the greater technical effectiveness.** This finding, coupled with the argument advanced by

---

*The concept of task interdependence is central to the contingency theory of organizations and is introduced in Section 5.1.

**Technical effectiveness refers to effectiveness in resource procurement, productivity and production (Jenkins and Ortolano, 1978).

Jenkins and Ortolano (1978) that environmental specialists involved in a planning role exhibit reciprocal interdependence with planners, suggests that if planners and environmental specialists rely more on communication mechanisms which denote coordination by mutual adjustment, the influence of environmental factors on planning decisions might be enhanced.

Thompson (1967, p. 56) notes further that coordination by mutual adjustment generally calls for more frequent communication involving feedback and the transmission of new information. Rogers (1976) suggests several attributes of such communication which reflect message frequency, message content, and opportunities for feedback. The observations noted above suggest that if communication between planners and environmental specialists is more frequent, transmits more new information and ideas, and allows feedback, i.e., it represents coordination by mutual adjustment, then the influence of environmental factors on Corps decision making may be enhanced.

Components of Analysis*

To ascertain the extent of use of various communication mechanisms denoting the three types of coordination noted above (i.e., standardization, planning, and mutual adjustment) the study managers and environmental specialists interviewed were asked (individually) to indicate, on scales from 1 (little or none) to 5 (used exclusively), the extent to which they relied on each of five mechanisms in communicating with each other during the study. These mechanisms included: existing reports, office memos, reliance on superiors, use of project teams, and informal relationships. Inasmuch as the last two of these mechanisms connote coordination by mutual adjustment, the *a priori* hypothesis would be supported if positive associations were found between the dependent variables and the extent of use of project teams and informal relationships for communication. Reliance on the more formal mechanisms (i.e., reports, office memos, and superiors) would not be expected to show positive associations with the dependent variables.

---

*For a listing of the actual interview questions used and an example of score computation, refer to Appendix A, Section 2.

With regard to the attributes of coordination by mutual adjustment, study managers and environmental specialists were also asked individually to indicate on ordinal scales* the frequency with which they had verbal communication with each other, the frequency with which feedback was requested or provided, the proportion of communication which was innovation rather than task oriented, and the proportion of communication between the two which had been initiated by the environmental specialist. These ordinal scales were worded such that greater frequencies and proportions were coded as higher numbers; thus the _a priori_ hypothesis would be supported by positive associations between the dependent variables and these communication attributes.

Results of Analysis

With regard to the analysis of the mechanisms of communication described above, no significant correlations were found between the dependent variables and the responses of study managers. However, a significant _negative_ correlation was noted between the formulation variable and environmental specialists' perceptions of the extent to which standard forms and office memos were used in communication between them and study managers ($p < .10$). This finding suggests that, in Survey Investigations, reliance on coordination by standardization, i.e., the type of coordination viewed by Thompson (1967) as most appropriate for tasks having only pooled interdependence, may hinder the consideration of environmental factors in planning. A significant _positive_ correlation, supporting the _a priori_ hypothesis, was noted between the formulation variable and environmental specialists' perceptions of the extent of use of project teams as communication mechanisms ($p < .05$). This finding suggests that the reliance of planners and environmental specialists on coordination by mutual adjustment may enhance the consideration given environmental factors in Survey Investigations.

The modification variable showed a significant _positive_ correlation with environmental specialists' perception of the use of existing documents as a mechanism of communication with study managers. This result, which is counter to the _a priori_ hypothesis, may reflect increased reliance on existing documentation in older studies as sources of information. That this reliance shows a strong association with the modification variable suggests that in older studies where more changes are being contemplated in response to environmental concerns, environmental specialists consult more frequently the documentation they already have in hand. In any case, the _a priori_ hypothesis appears not to be supported in the sample of older studies.

---

*The terminology used in these five point scales was different for the different attributes. Refer to Appendix A, Section 2 for a listing of the response categories used.

Noting that Hill (1977, p. 174) cites reliance on more formal, bureaucratic coordination procedures as an obstacle to effective interdisciplinary planning, the responses of both study managers and environmental specialists to the questions regarding communication mechanisms were used to construct an index* of _communication informality_. This index takes on higher values if planners and environmental specialists rely more on the use of informal communication mechanisms (i.e., project teams and informal relationships) and less on the use of formal mechanisms (i.e., existing documents, office memos, and reliance on superiors). A significant positive correlation was found between this index and the formulation variable ($p < .05$) suggesting that greater reliance on informal mechanisms of communication permits the amount of dialogue between environmental specialists and planners necessary for an increased influence of environmental information on plan formulation. However, the index was found to be _negatively_ correlated with the modification variable ($p < .05$). One possible explanation for this result is that, in older studies where significant changes are contemplated to a Congressionally authorized plan, planners and environmental specialists are more concerned that their deliberations are "on the record". In any case, these findings lend support to that portion of the _a priori_ hypothesis dealing with Survey Investigations (i.e., plan formulation) but lead to rejection of the _a priori_ hypothesis for the population of older studies.

With regard to the attributes of communication between planners and environmental specialists examined in this research, no clear support for the _a priori_ hypothesis was found in bivariate analysis of the responses to individual question items. However, it was noted that the inter-item correlations between the responses of both study managers and environmental specialists characterizing frequency of verbal communication, extent of feedback provided, and proportion of communications dealing with innovation, were quite high. To ascertain whether these concepts, taken as a group, would show a notable relationship to the dependent variables an index was constructed* which is thought to reflect the degree to which communication between planners and environmental specialists was interactive communication. This index showed a significant positive correlation with the formulation variable ($p < .05$), however, no relationship was evident for the modification variable. One explanation for this finding is that the transfer of ideas between environmental specialists and study managers is most important in the early stages of planning when more creativity is required; in contrast, issues affecting the modification of plans and projects are less concerned with working relationships between planners and more on external factors. In any case, the positive association found between the formulation variable and the interactive communication index lends support to the *a priori* hypothesis that more open, direct communication between study managers and environmental specialists enhances the consideration given environmental factors in the formulation of alternative plans.

---

*The technique of index construction is discussed in Section 3 of Chapter 3. The questions utilized in this particular index can be found in Appendix A, Section 2.

Use of Interdisciplinary Teams

The finding noted above that increased reliance on project teams as a communication mechanism was associated with higher scores on the formulation variable suggested that further elaboration of this topic might be in order. Section 102(2)(A) of NEPA requires the use of "a systematic interdisciplinary approach" not only in the preparation of EIS's but also in evaluation of project alternatives early in the planning process. Corps procedures (1974) and CEQ guidelines (1973) also require the use of interdisciplinary teams in project planning. Several other questions relating to the use of interdisciplinary planning were asked during the field interviews conducted for this research.* In particular, both study managers and environmental specialists were asked whether they viewed "formal interdisciplinary teams" to have been established in their respective studies.** Formulation variable scores were found to be substantially higher in the studies where both respondents viewed such teams as having been formally established, although the difference, using the median test, was significant only at p=.13. Thus while the use of interdisciplinary teams may enhance the consideration of environmental factors in plan formulation, the data obtained in this research do not indicate this conclusively. It is notable that in only 5 of the 14 recent studies did both respondents (i.e., study managers and environmental specialists) view interdisciplinary teams to have been formally established. Thus it appears that, despite guidance to the contrary, the use of interdisciplinary teams in Survey Investigations is the exception rather than the rule.

---

*The technique of index construction is discussed in Chapter 3, Section 3. This particular communication index is described in greater detail in Appendix A, Section 2.

Not addressed in this discussion so far is the distinction between interdisciplinary and multidisciplinary planning. Dorcey and Fox (1973) describe the difference as follows:***

> "...multidisciplinary programs may have a number of individuals pursuing objectives which are loosely related to one another whereas the interdisciplinary project constitutes an integrated set of studies designed to achieve a common goal."

Other data suggest that multi-disciplinary rather than interdisciplinary planning is the rule. More than half the environmental specialists interviewed in the sample of recent studies felt they had "little" or "no" influence in the fundamental planning tasks of problem definition and alternative formulation and more than two-thirds felt they had "little" or "no" influence in plan selection. On the other hand, more than three-fourths felt they had a "moderate" or "large" influence in impact assessment.* This apparent concentration on the impact assessment role is not surprising since the growth of the ER unit in the Corps planning process is clearly the result of the requirement for environmental impact statements, but it points out the fact that the "systematic _inter_disciplinary approach" required by NEPA is not yet widely used.

---

*These questions and the methods used for scoring them are described in Appendix A, Section 2.

**Formal interdisciplinary teams were considered established if they were viewed as such by both respondents, if the membership of such teams included at least 3 disciplines and included an environmental specialist, and if such team had met as a group at least once during the study.

***The distinction made by Dorcey and Fox concerned research programs; Hill (1977) has elaborated on its relevance to water resources planning.

5.3 Perceived Role

The _a priori_ hypothesis regarding role perception is as follows:

> "The influence of environmental information on the formulation of alternative plans, and on the modification of a proposed plan, will be increased if the study manager perceives the duties of the environmental unit to include the broader activities of formulation and evaluation rather than specific, narrowly defined tasks."

Randolph (1976) found, in his case studies of Corps planning in California, that the study manager plays a dominant role in the conduct of Corps planning studies, determining to a large degree the types of alternatives to be considered and the ways in which alternatives would be studied. This observation suggests that if study managers perceive the responsibilities of the ER unit in planning to be narrowly defined and limited (e.g., restricted to preparing EIS's), this perception would, in fact, determine the role the study manager would allow the ER unit to play in planning. Furthermore, Hill (1977 , p.174) found, in his survey of Corps planners and environmental specialists, that many environmental specialists view themselves as technical consultants to planners rather than planners themselves. While not a part of the _a priori_ hypothesis this suggests that environmental specialists' own role perceptions may also affect their involvement in the planning process and the consideration given environmental factors in planning.

---

*As a part of the field interviews conducted for this research study managers and environmental specialists were asked to indicate, on scales from 1 (no influence) to 5 (dominant influence), the degree to which each of 10 "actors" had influenced decisions relating to the four fundamental planning tasks of problem definition, alternative formulation, impact assessment, and plan selection. The responses to this series of questions are used throughout the analysis reported in this and subsequent chapters as references to corroborate or refute interpretations of other relationships. This use of multiple measures to "triangulate" provides greater confidence in the interpretations herein reported. For a listing of the actual questions used in this regard refer to Section 6 of Appendix A.

Components of Analysis*

Role perception was ascertained by asking both study managers and environmental specialists individually what they believed to have been the primary function of the ER unit in that planning study and what they believed to have been the next three most important functions. These open-ended responses were then analyzed subjectively by the researcher to determine the extent to which the following six specific planning tasks were mentioned: problem definition, setting of study objectives, alternative formulation, impact assessment, alternative ranking or evaluation, and coordination with outside interests (e.g., agencies, interest groups, and the public). A score of "1" was then assigned for each planning task if that task was one of the functions mentioned in response to the questions, otherwise a "0" was assigned. These individual scores were then summed to obtain a breadth of role index for each respondent. These two indices thus described the study manager's perception of the role of the ER unit in the study and the environmental specialist's perception of the role of the ER unit in the study. Since higher values of the index were associated with a broader perception of the role of the ER unit, the _a priori_ hypothesis would be supported by a positive association between the study manager's breadth of role index and the dependent variables.

Results of Analysis

While other data show that study managers are, in fact, perceived to be the dominating influence in all four fundamental decision-making tasks in planning (i.e., problem definition, alternative formulation, impact assessment and plan selection) no significant relationships were found between the breadth of role index, based on study manager's responses, and either of the dependent variables.* This suggests that the a priori hypothesis regarding role perception should be rejected. Strong positive but non-significant correlations were found, however, between the breadth of role index, based on environmental specialist responses, and both the formulation and modification variables. This suggests that the environmental specialist's perception of his or her own role in a planning study may be a greater determinant of the influence of environmental considerations in planning than study manager's. A subjective impression gained from the field interviews for the research reported on herein is that the self-motivation of environmental specialists to become involved in all aspects of planning is an important factor in determining the extent to which they influence planning decisions. Unfortunately, the measure used was not sensitive enough to permit an assessment of the environmental specialist's motivation to become involved in all aspects of planning. However, in response to another question regarding the adequacy with which environment factors had been addressed, several study managers cited a lack of initiative on the part of environmental specialists as an important reason that inadequate consideration may have been given to environmental factors in their planning studies. The issue of the relationship between individual attitudes and planning outcomes is addressed further in Chapter 6.

---

*For a list of the actual interview questions used and an example of score computation refer to Section 2 of Appendix A.

5.4 Conflict Resolution

The a priori hypothesis regarding conflict resolution is as follows:

> "The influence of environmental information on the formulation of alternative plans, and on the modification of a proposed plan, will be increased if the role of the environmental specialist in the resolution of conflict is increased."

The existence of conflicts between study managers and environmental specialists can occur because of opposing values, views, or judgments regarding choices between various strategies, alternatives or policies affecting the course of the planning study. When such conflicts are resolved, the environmental specialist is considered to have a greater role if an open, frank discussion of differences is used and compromises are sought and if the situation is not characterized by the domination of the study manager or the conscious avoidance of controversy by the environmental specialist.

---

*For a listing of the questions used to determine perceived influence refer to Appendix A, Section 6. These questions are also discussed in Section 5.2 above.

Using the typology of Blake and Mouton (1964), five modes of conflict resolution were analyzed in this research: 1) confrontation - the explicit discussion of all views and doubts, 2) compromise - the active seeking of a middle ground, 3) forcing - the imposition of will upon others, 4) smoothing - the glossing over of differences, and 5) withdrawal - the deliberate avoidance of conflict. In his contingency analysis of two water resources planning offices, Jenkins (1977) found confrontation to be the primary mode and compromise to be the secondary mode of conflict resolution in the water resource planning agency having the greater perceived organizational effectiveness. The *a priori* hypothesis above is based largely on Jenkins work. Support for the hypothesis would be evidenced by higher dependent variable scores on studies where conflicts between study managers and environmental specialists were resolved through confrontation and compromise.

Components of Analysis*

Lawrence and Lorsch (1967) used a series of proverbs and sayings related to the five modes of conflict resolution noted above to study the ways in which conflicts were resolved in an industrial organization. In the research reported on herein, a subset of these proverbs and sayings used by Lawrence and Lorsch were applied to the analysis of conflict resolution in the context of a planning study as opposed to the organization as a whole. Observe that, whereas Lawrence and Lorsch interviewed a large number of organization members to make their determination of the modes of conflict resolution used, the present research relied only on interviews with study managers and environmental specialists. The use of only these two respondents was necessary since the significant contacts between the ER and planning units within the District Office involve only these two people. As elaborated below, this particular adaptation of the approach followed by Lawrence and Lorsch is suspect.

---

*For a list of the actual interview questions used and an example of score computation refer to Section 2 of Appendix A.

Study managers and environmental specialists were each given a list of fifteen proverbs, three for each of the five modes of conflict resolution noted above, and asked to indicate on a scale from 1 (rarely or never) to 5 (very frequent) the degree to which each saying reflected the resolution of conflicts between the two during the course of the study. After the data had been collected, indices describing the extent of use of each mode were constructed using the responses to the three proverbs associated with each mode. Positive associations between the dependent variables and the indices thus constructed for the confrontation and compromise modes would be expected if the a priori hypothesis were true.

Results of Analysis

The a priori hypothesis was not supported by the analysis of the data involving conflict resolution. As is generally the case there are essentially two possible explanations: (1) the a priori hypothesis is false, or (2) the method of measurement of conflict resolution was invalid. In this instance there are indications that the latter is the case. The evidence for this consists of the results of cluster analysis* performed to ascertain whether the responses to the individual proverbs reflecting a particular mode exhibited strong inter-item correlations. These responses did not show such correlations and thus could not be viewed overall as valid measures of the five modes. This result should not be viewed as a criticism of the efforts of Lawrence and Lorsch (1967) or of the application of this method by Jenkins (1977). These researchers used the proverbs in a different context. They had a relatively large number of respondents who gave information characterizing the approach to conflict resolution in a particular planning office. The research reported on herein relied on only two respondents to characterize the approach to conflict resolution on a particular study. These differences in the number of respondents used per unit of analysis (office vs. study) may well explain why the Lawrence and Lorsch approach to measuring conflict resolution did not provide a valid measure in the present research.

---

*Cluster analysis is a statistical technique used to identify subsets of empirically related items out of a larger set of items (see, e.g., Dixon, 1975).

Although the quantitative analysis of the conflict resolution data did not yield insights into the validity of the *a priori* hypothesis, there are some qualitative impressions gained during the field interviews concerning conflict resolution. Several interviewees in the sample of recent studies indicated that specific disagreements between environmental specialists and study managers didn't exist. In contrast, several environmental specialists in the sample of older studies, after making note of fairly well defined points of conflict, mentioned that environmental factors received what they felt was adequate consideration when conflicts were confronted openly and frankly. This suggests that the hypothesis may be worthy of further testing, at least in the case of older studies. Before doing so, however, it will be necessary to develop a valid measure of the modes of conflict resolution.

Chapter Six

ENVIRONMENTAL ATTITUDES AND VALUES IN DECISION MAKING

This chapter examines the relationship between individual attitudes regarding the role of environmental considerations in planning and the outcomes of the planning process, namely, the two dependent variables, which indicate the influence of environmental factors on plan formulation and plan modification. The a priori hypothesis is as follows:

> "The influence of environmental information on the formulation of alternative plans, and on the modification of a proposed plan, will increase if the study manager has a more positive attitude regarding the significance of environmental factors in planning."

Two key assumptions underly this hypothesis. The first, that attitudes significantly affect behavior, is one typically made by behavioral scientists (Cohen, 1964). The second assumption is that the behavior which is predisposed by the attitudes of interest in this study will be reflected in the planning outcomes, i.e., the two dependent variables. Randolph (1976), in case studies of Corps planning in California, found that study managers could play a dominant role in determining which alternatives were to be considered, what studies were to be done, and how information was to be obtained and transmitted; he suggested that their attitudes about the importance of environmental factors in water planning might play a significant role in determining how much consideration is given to environmental factors. Hill (1977, p. 129), finding a relatively large amount of anti-environmentalist sentiment in a survey of Corps planners and environmental personnel, also suggests that the implementation of NEPA may be affected by the attitudes of study managers.

Two methods were used to obtain numerical measures of attitudes. The method presented first, Guttman scaling, uses a series of closed-ended opinion statements which satisfy well established criteria relevant to the formation of scales. The second method used is an open-ended value assessment technique known as ECHO (de Mille, 1970), and it is discussed in the second section of this chapter.

6.1 Guttman Scaling

The Guttman scale, more commonly referred to as the unidimensional scale, is a measurement technique widely used by sociologists and social psychologists and is the subject of a large body of literature in the behavioral sciences (Dotson and Summers, 1970). The technique was developed by Louis Guttman in the late 1930's and early 1940's (see, e.g., Guttman, 1941) and was later refined by Goodman (1959), among others. The technique rests on two concepts, unidimensionality and scalability. The concept of unidimensionality is concerned with the degree to which the opinion statements comprising the scale all elicit responses based on the same underlying opinions or attitudes. If a respondent replies to all the statements in the scale based on feelings or perceptions about the same thing then the scale may be considered unidimensional. While unidimensionality requires that all the statements in the scale address the same underlying attitude, the concept of scalability requires that the statements be different in terms of intensity. The intensity structure of a scale can be understood by drawing an analogy between a scale and a series of hurdles of increasing height (Campbell, 1963). The ability of a hurdler to clear all the hurdles can be described by a single number, namely, the height of the highest hurdle that can be cleared successfully. Given that number, one can predict that the hurdler will succeed in clearing all hurdles of a lesser height and fail to clear all those of a greater height. A Guttman scale consists of a series of opinion statements of varying severity, which indicate positions along some attitudinal "dimension" of interest. If these statements are placed in order of increasing severity, an individual's position on that attitudinal dimension can be described by the rank number of the most severe opinion statement to which he will agree. Knowing this number, or "scale score", the individual could be expected to agree with (or "pass") all statements of lesser severity and disagree with (or "fail") all statements (or "items") of greater severity. Thus, as the height of the hurdle describes the hurdlers' ability in a physical dimension, so does the scale score of an individual describe his "psychological ability" in some attitudinal dimension. The problem at hand thus becomes one of defining the attitude of interest and developing a series of opinion statements reflecting that attitude and meeting the criteria used to help establish the existence of unidimensionality and scalability.

Unidimensionality is determined for a sample of responses on the basis of item analysis* using inter-item and scale-item correlations (see, e.g., Babbie, 1973). Statement responses which appear related are compared with each other and with the sum of all other statements. Responses which are negatively correlated are deleted until a subset is found such that all are positively correlated with each other and with the sum of all other responses. The stronger these correlations are, the more confidence can be placed in the unidimensionality of the scale.

Scalability may be determined on the basis of two coefficients, the coefficient of reproducibility (COR) and the coefficient of scalability (COS). Both rely on the identification of "errors" in individual response patterns. An error occurs whenever an individual passes a given item and fails an item of lesser severity. To compute the COR, the total number of all such errors is divided by the total number of responses (i.e., the product of the number of items and the number of respondents) and the result is subtracted from unity. Thus the COR is a measure (for the entire sample) of how well the scale scores of the individuals predict their overall response patterns. If no errors occur in the entire sample, the COR will be unity; the more errors that occur, the lower the COR will be. Values of 0.9 or greater are considered acceptable COR's for Guttman scales (Nie, et al., 1975, p. 533). The COS, considered by some (e.g., Menzel, 1953) to be a better indicator of scalability, is determined by comparing the COR for the desired ordering of items to the "minimum COR";** i.e., the smallest COR which could be obtained by using the response data to compute the COR associated with each of the many possible orderings of the items comprising the scale. This coefficient varies from zero to one and values of 0.6 or greater are considered acceptable COS's for Guttman scales. The correlations between items and scales and the values of the two coefficients just described provide the analytical basis for evaluating the Guttman scales.

---

*Recall from Chapter 3 that the item analysis exercise identifies groups of responses which are related empirically.

**The term "percent improvement" is defined as the difference between the COR computed for items as ordered in the proposed scale and the "minimum COR." The percent improvement divided by the difference between unity and the minimum COR yields the COS (Nie, et al., 1975, p. 533).

Early Scale Development

The first stages of the development of the Guttman scales used in this research consisted of defining the attitude dimensions of interest and writing opinion statements reflective of varying extremes of those attitudes. The attitudes of interest concerned the balancing of environmental considerations against the economic considerations which arise in the planning context. Opinion statements reflecting tradeoffs between environmental concerns and three areas of economic concern were developed. These three areas of economic concern are: the balance of tangible benefits and costs provided by the alternatives under consideration, the regional economic development potential allowed by the various alternatives, and the weight to be given economic considerations in the planning study. All three of these areas may be subject to tradeoffs when environmental preservation or enhancement are being considered. These three areas of tradeoff then defined three attitudinal dimensions of interest. For each, several statements were developed reflecting willingness to forego varying degrees of economic benefit or development potential in return for environmental preservation and enhancement. In all, 21 such statements were developed.

These statements were then pretested on a sample of 133 students enrolled in two classes (construction management and environmental planning) at Stanford University. While this sample was not drawn from the population of interest, it was felt that the exercise would allow meaningful preliminary evaluation of the scales since the disciplines represented by these students (predominantly engineers) were similar to those of most study managers. Analysis of the results of the pretest showed that it would be possible to develop Guttman scales meeting the scalability criteria if items posing more extreme tradeoffs were added to the 21 items that were used. The pretesting resulted in a larger number of high scale scores (pro-environmentalists) than would be desirable for meaningful correlation analysis.

Based on the pretest, three more extreme items were added to the list of 21 and the full list of 24 items was used in the field interviews with study managers.*

Final Scale Development and Scoring

Since a Guttman scale is developed from a body of empirically obtained data, a series of statements can be said to comprise a Guttman scale only for that body of data. In order to develop as general a set of scales as possible the responses of the 26 study managers participating in the Corps of Engineers field interviews were combined with similar responses from Caltrans and Bureau of Reclamation respondents.** This pooling of data provided a sample of 71 respondents upon which to evaluate the various scales.

The procedure used to identify the final scales to be used was essentially that described above. First, a candidate set of items was chosen from among the 24 items used in the field interviews; then a computerized statistical procedure, Guttman Scalogram Analysis (Nie, et al., 1975), was used to evaluate unidimensionality and scalability. This process was repeated for a number of different subsets of the 24 items. This overall procedure yielded three sets of items which could be said to comprise Guttman scales.

Figure 6-1 presents these three scales. The first, Scale A, is interpreted as reflecting varying degrees of willingness to forego quantifiable project benefits to obtain environmental preservation and enhancement. The second, Scale B, is interpreted as expressing willingness to forego opportunities for economic development and growth to preserve and enhance environmental quality. The third, Scale C, is more general, combining aspects of both Scale A and Scale B with new items also characterizing tradeoffs

---

*For a listing of the interview questions used and an example of score computation, refer to Section 3 of Appendix A.

**Recall that the research reported herein is part of a larger effort involving the California Department of Transportation and the U.S. Bureau of Reclamation. Since the role of study managers' attitudes regarding the significance of environmental factors in planning is of interest in all three research studies, scales applicable to all three agencies were desirable.

FIGURE 6-1

GUTTMAN ATTITUDE SCALES

SCALE A

1. Preservation measures should often be included in public projects even if they don't improve the overall benefit-cost ratio.
2. Environmental considerations should be allowed to dictate significant reductions in other project benefits.
3. The expense required for environmental enhancement measures does not need to be justified by equivalent environmental benefits.

Pooled Sample	Recent Studies	Older Studies
COR = .912	COR = .846	COR = 1.000
COS = .679	COS = .500	COS = 1.000
N = 71	N = 14	N = 14

SCALE B

1. Environmental enhancement should not be excluded from project proposals because of constraints on regional economic growth.
2. Moderate decreases in regional economic development are acceptable in return for the preservation of natural areas.
3. It would be acceptable to allow great reductions in the economic growth of the study region in order to avoid project-related environmental degradation.
4. Increased unemployment in the study area is justified by a desire to preserve the environment.

Pooled Sample	Recent Studies	Older Studies
COR = .923	COR = .792	COR = .958
COS = .692	COS = .231	COS = .714
N = 71	N = 14	N = 14

FIGURE 6-1

GUTTMAN ATTITUDE SCALES (Cont.)

SCALE C

1. The overall benefits which result from environmental enhancement measures often justify the expense which is required for implementation.
2. Moderate decreases in regional economic development are acceptable in return for the preservation of natural areas.
3. Environmental considerations should be allowed to dictate significant reductions in other project benefits.
4. Environmental preservation measures could be justified even if it meant putting a stop to future economic growth in the region.
5. The expense required for environmental enhancement measures does not need to be justified by equivalent environmental benefits.

Pooled Sample	Recent Studies	Older Studies
COR = .859	COR = .939	COR = .859
COS = .534	COS = .750	COS = .455
N = 71	N = 14	N = 14

between environmental and economic benefits and costs. The items in the scales are ordered from least to most severe.* Below each scale are the coefficients of reproducibility and scalability for the pooled sample, the sample of Corps Survey Investigations (recent studies) and the sample of Corps Phase I studies (older studies).

Once scales were developed there remained the task of assigning to each respondent a scale score reflecting his response pattern for that particular scale. Inasmuch as each respondent replied to each statement by indicating the extent of his agreement,** this was accomplished by considering agreement as "passing" the statement and non-agreement (neutrality) or disagreement as "failing". In this manner each response pattern was converted to a series of 0's (fails) and 1's (passes) which were then added to obtain the total number of "passes". Note that this procedure for scoring assumes no errors in individual response patterns. Some opinion researchers argue that response patterns containing errors should be corrected using various techniques (see, e.g., Henry, 1952, or Lazarsfeld, 1951) and revised scale scores assigned to those respondents, others argue that scales passing the stringent criteria of the COR and the COS will contain few errors anyway and that simply adding the number of "passes" is a sound procedure (Nie, et al., 1975, p. 533). The latter approach was used to assign scale scores in this research. Thus the scale scores ranged from 0 to 3, from 0 to 4, and from 0 to 5 for the three scales, respectively, higher numbers indicating more positive environmental attitudes.

The assignment of scale scores is the last step required before correlation analysis can begin. Observe that: (1) the scale scores are higher for respondents expressing willingness to forego greater economic benefits for environmental quality goals and (2) the dependent variables, which are assumed, for the present purpose, to reflect the behavior of the respondent, are higher for studies where environmental considerations played a greater role. Thus a significant positive correlation between scale scores and the dependent variables can be interpreted as support of the *a priori* hypothesis.

---

*The order of the items shown in Figure 6-1 is not the order that was used in administering the questions to study managers. In administering the attitude measures this order was jumbled and approximately half the statements reversed to have a "sense" that was the negative of the statements shown.

**Respondents were asked to circle the extent of their agreement with each statement on the basis of the following scale: -2, strongly disagree; -1, disagree; 0, neutral; +1, agree; and +2, strongly agree.

Results of Correlation Analysis

Table 6-1 presents the results of the rank order correlation analysis of the Guttman attitude scales. No significant positive correlations were found and, in fact, three significant negative correlations were found, Thus, the *a priori* hypothesis must be rejected. Further analysis was undertaken to better understand the negative relationships found. This, together with a more qualitative perspective of the Corps planning process and the particular planning studies involved, yielded some interesting interpretations of the findings.

The most obvious explanation of the results presented above relates to one of the two assumptions made at the outset of the Guttman scaling exercise, namely,that the behavior of individual study managers would be strongly reflected in the dependent variables. The planning process is often complicated, opportunities for the influence of other actors (e.g., Corps hierarchy, the local sponsor, and others) is generally great and institutional constraints, such as the need for economic justification, often intervene to affect outcomes. Furthermore, in some of the longer studies, the earlier stages of the planning process had been influenced by other individuals serving as study managers. Thus it seems that the *a priori* hypothesis,which attached considerable importance to the attitudes of the study managers, was just too simplistic. To expect a significant bivariate relationship between the attitudes measured by the Guttman scales and the dependent variables is to ignore the many other factors, many beyond the control of study managers, which affect planning outcomes.

In an attempt to minimize the effects of some of these other factors, additional correlations were computed. For one series of correlations, the planning studies where no economically feasible plans could be found were eliminated from the sample.* In another series of correlations, studies in which both study managers and environmental specialists perceived there to be no appreciable environmental resources in the study area were deleted from the samples.** The results of these analyses suggest that the strong negative correlations noted in Table 6-1 may be spurious,

TABLE 6-1

GUTTMAN SCALE CORRELATION COEFFICIENTS (τ)

(N = 14)

Attitude Scale	Formulation Variable	Modification Variable
(Scale A) Respondent's attitude toward the tradeoff between economic costs and benefits of environmental protection measures.	-	-
(Scale B) Respondent's attitude toward the tradeoff between regional growth/development and environmental protection measures.	$-.3216^{+}$	$-.3770^{+}$
(Scale C) Respondent's attitude toward the value of environmental protection relative to general economic considerations.	$-.3561^{++}$	-

+ denotes significance at $p < .10$.

++ denotes significance at $p < .05$.

- denotes no significant correlation found.

---

*The deletion of studies where no feasible plans could be found eliminated two of the recent studies but none of the older studies.

**Both study managers and environmental specialists were asked to indicate, on ordinal scales from 1 (none found) to 5 (found throughout), the extent to which each of 10 environmental resources or attributes (e.g., rare or unique vegetation, free flowing streams with undeveloped shorelines) which might possibly be affected by Corps action were to be found in the study area. For a description of the questions used in this regard, refer to Section 6 of Appendix A.

since they were substantially reduced in these additional analyses. This suggests at least two qualifying conditions which would have to be met before a meaningful relationship could be expected between attitude scores and the dependent variables: 1) there must be at least some appreciable environmental resources in the study area that might be affected by proposed projects,and 2) that economically feasible alternatives must be available since, if no economically justifiable plans can be readily identified, planners have little reason to conduct environmental analyses of the impacts of these plans and no opportunities for environmental attitudes to affect decision making will present themselves.

Another factor which clearly prevents the influence of an individual study manager from being reflected strongly in the outcomes of the planning process is the fact, that in studies of long duration, more than one individual may be responsible for directing the planning process as the study manager. To ascertain whether this situation might be the reason for the apparent lack of support for the a priori hypothesis the two recent and three older studies in which the early stages of planning had been influenced by other study managers were deleted from the samples and correlations between the attitude scores and the dependent variables computed again. This resulted, however, in only slight reductions in the negative correlations noted in Table 6-1 suggesting that other intervening factors, such as those already discussed, are sufficiently strong to inhibit individual attitudes from dominating planning outcomes.

Another possible general explanation of the results in Table 6-1 is that the particular attitudes measured, i.e., the three scales presented in Figure 6-1, are not the most important attitudes affecting planning outcomes. As is elaborated in the next section, many study managers view the local sponsor as the entity which must be the most satisfied with planning outcomes; many of these study managers view public involvement as the primary means by which the desires of local publics are ascertained. Environmental factors might therefore be influential only when the local sponsors feel that such factors need to be considered. This suggests that attitudes toward the role and value of public involvement might be more influential in determining planning outcomes than the attitudes reflected in the scales in Figure 6-1.

All things considered, the a priori hypothesis must be rejected as being entirely too simplistic. This result is not surprising since few behavioral scientists find strong relationships between verbally expressed attitudes and overt behavior unless those attitude measures are very specific. Situational influences, such as the institutional constraint imposed by economic evaluations, are cited by many (e.g., Wicker, 1969) as often greater determinants of behavior. Likewise, competing attitudes, such as those toward public involvement, are also considered to be an important characteristic of any attitude-behavior relationship (Gross and Niman, 1975). The next section on value assessment provides insights into some of these competing attitudes.

6.2 ECHO Value Assessment

Because Guttman attitude scaling relies on a set of opinion statements devised by the researcher, the attitudes to be assessed by the technique must be defined a priori. While Guttman scaling is an established and highly refined method, this reliance on prior definition of an attitude dimension of interest can be a shortcoming where uncertainty exists regarding which dimensions to address. If the researcher addresses an attitude dimension later found to be not the most important for the purpose at hand, the data resulting from the measurement has little value; it is not likely that such data could be used to construct new measures more congruent with the researchers' ends. A technique which mitigates this shortcoming, the ECHO technique, was included in the field interviews to provide a second, supplementary measure of attitude.*

Originally developed by Bavelas (1942), the open-ended value assessment method now known as ECHO has found a great deal of application in situations where the cultural setting is unfamiliar to researchers and in situations where the precise attitude dimensions of interest are unknown. Its format varies from application to application but the open-ended questions used typically ask respondents to describe types of behavior which they would consider "good" or "bad" in the context of familiar (to the respondents) social settings, e.g., their work environment. Responses to these open-ended questions are then classified into similar categories using either specially trained judges or judges selected from groups of the respondents' peers. The categories of responses and the number of responses in each can then be examined to obtain an understanding of the value systems of the respondents (Barthol, 1974). Thus ECHO provides the means to identify the value categories most important to the respondents, the sources of approval/disapproval for actions considered good or bad, and a great deal of other information about the situational influences affecting respondents.

---

*For a description of the interview questions used and an example of score computation, refer to Section 3 of Appendix A.

Data Collection and Scoring

In the present research the open-ended questions were designed to reflect the context in which the respondents work. Each study manager and environmental specialist* participating in the field interviews was asked:

> "What would be the best thing that you did or could have done in this planning study for which you might receive praise?"**

This question was repeated substituting "another good thing" for "the best thing" until the respondent could not think of any more responses or had provided five responses. Then each respondent was asked:

> "What would be the worst thing that you did or could have done in this planning study for which you might be criticized?"

---

*Although the attitudes and values of environmental specialists are not a part of the *a priori* hypothesis, the great informational utility of ECHO and the ease of data collection led to their inclusion in this exercise.

**This wording differs somewhat from that used in the Caltrans and Bureau of Reclamation portions of the overall research study. In those portions, more stress was placed on the receipt of praise or approval and hence, in those portions of the research, "*might* receive praise" was changed to "*would* receive praise". In pretesting done for the Corps portion of the study it was noted that praise was seldom given for "good" actions and that study managers' self-satisfaction with certain types of behavior would be an important motivation for their responses. The present wording was adopted to lessen the likelihood that respondents would focus on sources of praise or criticism rather than on describing the types of behavior which they perceived as "good" or "bad".

This was repeated in a similar fashion substituting "another bad thing" for "the worst thing". This questioning, conducted early in the interview, yield several "good" and "bad" responses from each respondent as well as sources of praise and criticism for each.

The next stage in the ECHO procedure is to classify similar responses into categories. For the present research this was accomplished in two steps. The first step relied on preliminary classification by the individuals carrying out the research, while the second utilized classification by the respondents. As elaborated below, this two step classification procedure was adopted so that the amount of effort required of respondents could be kept at a reasonable level, allowing each respondent classifier an opportunity to judge each response. Initially all responses were written on individual "3 x 5" cards and divided into two groups, responses to "good thing" questions in one and "bad thing" questions in the other. Each of four members of the research team* then independently grouped together responses that seemed to have similar meaning and kept a record of these groupings. These independent judgings and a final judging exercise by the entire team resulted in consensus regarding the grouping of approximately 90% of all the responses.** This process produced four different sets of categorized responses; there were four sets produced since there were "good" and "bad" responses from both study managers and environmental specialists.

The next step of the classification procedure involved additional judging of response classifications by the study managers and environmental specialists who had actually participated in the field interviews. The study managers who had participated in the field interviews were divided into two groups. Each study manager in one group was then sent a typed list of the study manager responses to the "good thing" questions presented in the preliminary classification scheme resulting from the judging by the research team. Each study manager in the other group was sent a typed list of the study manager responses to the "bad thing" questions also presented in the preliminary classification scheme of the research team judges. This same procedure was followed with environmental specialists, i.e., they were divided into two groups and members of each group were sent typed lists of the environmental specialist responses to the "good thing" and "bad thing" questions. The study managers and environmental specialists were then asked to look through the preliminary classifications and the unclassified responses and reclassify or assign individual responses to new categories as they saw fit. Thus each of the four sets of classifications arrived at by the research team was subjected to additional rounds of judging by the respondents themselves.*

---

*The research team was composed of all the individuals involved in the overall research project, as elaborated in Section 1.2.

**To lessen the likelihood of bias in this exercise a Corps planner, on leave and studying for a graduate degree at Stanford University, participated as part of the research group throughout this classification exercise.

Traditional application of the ECHO ends at this point, the final product being a consensus grouping or classification of the responses based on judgement by respondents or their peers. However, in the research reported herein, the ECHO method was used to evaluate individuals in terms of their attitudes toward the consideration of environmental factors in planning. Thus an additional scoring exercise was performed by the study managers and environmental specialists after their reclassification exercise to allow identification of "environmental" values. After reclassifying the individual responses on their lists, the study managers and environmental specialists were asked to score each category or group of responses and each unclassified response on a scale from 1 to 5 indicating the extent to which the responses showed concern for the incorporation of environmental factors in planning decisions.** In order to help guide the scoring exercise a list of factors to be considered "environmental" or "non-environmental" was developed based on the definition of environment adopted for the research.* As a result of this exercise each category of responses and each unclassified response was assigned several scores, one by each study manager or environmental specialist who had participated in the judging. The median of these scores for each category of responses was then adopted as the measure of "environmental value" for the category and its member responses. Similarly the median scores of unclassified responses were adopted as the measures of "environmental value" for those responses. These median scores were subsequently used in statistical analysis.

---

*The total number of study managers participating (half judging each subset) was 24 and the total number of environmental specialists was 16. Thus, at a minimum, each individual response was independently judged and classified 12 times, 4 times by the research staff and at least 8 times by respondents.

**The scale used was as follows: 1 = little or no concern, 2 = some concern, 3 = a fair amount of concern, 4 = quite a lot of concern, 5 = very much concern.

Categories and Values

Figure 6-2 shows, for study managers, the major categories resulting from the judging process, the number of responses comprising each category, and the median score of each category. Concern for public involvement dominates the responses of study managers in the population of newer studies. Generally speaking, "good things" to do in recent studies seem oriented toward an open planning process that yields an "environmentally sensitive" plan. Although "bad things" to do include some of these items (e.g., have poor public involvement), they include more responses concerning technical and administrative issues. In the population of older studies, study managers seem notably more concerned with technical and administrative issues. Meeting study schedules and producing efficient designs dominate the list of "good things" to do while bad engineering judgment and being unresponsive to local wishes are considered as "bad things". The apparent increased emphasis on meeting schedules and producing designs and the decreased emphasis on public involvement in the older studies is consistent with the nature of the Corps planning process. In Phase I planning, more detailed design questions are to be resolved and, in many cases, the desirability of the authorized project is merely reaffirmed; public involvement may consist of only a single public meeting (Randolph, 1976, p. A-5). This orientation may lead to a situation where

---

*Environmental factors were: ecology, habitat, archeology, air/water quality, community cohesion, aesthetics, land use, and outdoor recreation. Non-environmental factors were: economics, technical design, foundations, political acceptability, and traditional missions and outputs.

FIGURE 6-2

CATEGORIES OF ECHO VALUE RESPONSES
FOR STUDY MANAGERS*

RECENT STUDIES

	Number of Responses	Median Score
Good Things To Do		
Have good public involvement	7	3
Produce an environmentally sensitive plan	3	5
Meet study schedules	3	2
Look at a broad range of alternatives	2	4
Good coordination with locals	2	3
Educate people about the Corps	2	2
Get basic data earlier	2	2
Bad Things To Do		
Have poor public involvement	5	3
Look at a narrow range of alternatives	2	3
Let special interests dominate study	2	2.5**
Make poor engineering judgment	2	2
Conduct an inefficient study	2	2
Produce a poor design	2	2
Find no feasible project	2	1.5
Fail to meet schedules	2	1
Have problems in report review	2	1
Go against Corps policy	2	1

OLDER STUDIES

	Number of Responses	Median Score
Good Things To Do		
Meet study schedules	8	2
Produce an economical, efficient design	4	1
Look at a broad range of alternatives	3	4
Have good public involvement	2	3
Have good coordination with locals	2	3
Have good agency coordination	2	3
Develop dialogue with local sponsor	2	3
Get basic data earlier	2	2
Bad Things To Do		
Make poor engineering judgment	3	2
Be unresponsive to local sentiments	3	2
Ignore adverse effects	2	5
Fail to address environmental quality	2	5
Produce a poor EIS	2	4
Have poor public involvement	2	3.5
Have public relations problems	2	3
Poor agency coordination	2	2
Produce a poor design	2	2
Fail to meet study schedules	2	1

---

*Based on first three responses to "good thing" and "bad thing" questions.

**Non-integer values result when median is tied between two adjacent integer values.

the principal concern is to implement the plan promptly and avoid new issues which might cause delays. The Corps planning regulations themselves reinforce this perception by requiring additional paperwork and review for projects having significant changes in size, scope, location, or cost.*

Figure 6-3, which lists the major sources of praise and criticism for the actions described as "good" or "bad" by study managers and environmental specialists, provides further support for the notion that a principal concern of planners involved in older studies is getting the planning completed in a timely and efficient manner. The portion of Figure 6-3 concerning study managers indicates that, while the local sponsor is the major referent for praise or criticism in recent studies, it is third, significantly behind the District hierarchy, in the population of older studies. Thus it appears that, until an implementable plan is found, concern among study managers is for good public involvement and the generation of information that will lead to an acceptable plan. Once a plan has been found and approved by Congress, concern shifts away from the public and toward producing detailed designs promptly and efficiently.

Another interesting aspect of the results for study managers in Figure 6-2 concerns the types of responses that were judged to reflect a concern for incorporating environmental factors in planning decisions (i.e., the categories with high median scores). Such responses include production of environmentally sensitive plans and the consideration of a broad range of alternatives. It is noteworthy that issues related to production of economical, efficient designs and meeting study schedules, which are the most frequent responses from study managers on the older studies, received very low median scores. Thus, in the older studies, the types of things that are perceived as good things to do are not perceived as reflecting a concern for incorporating environmental values in planning. Whether or not this perception is associated with planning outcomes is a subject pursued in the section on Statistical Analysis presented below.

---

*This additional paperwork is the Post Authorization Change report (Corps, 1968) introduced in Section 3 of Chapter 2.

FIGURE 6-3

SOURCES OF PRAISE AND CRITICISM*

STUDY MANAGERS	Praise Source	Times Cited	Criticism Source	Times Cited
Recent Studies				
	Local Sponsor	12	Local Sponsor	12
	Self	11	Self	10
	Superiors	3	Superiors	4
	No One	3	Interest Groups	2
	Interest Groups	2	Misc.	3
	Misc.	3		
Older Studies				
	Self	12	Self	13
	Superiors	9	Superiors	7
	Local Sponsor	3	Local Sponsor	4
	No One	2	Interest Groups	3
	Misc.	4	Agencies	2
			OCE, BERH	2
			Misc.	3
ENVIRONMENTAL SPECIALISTS				
Recent Studies				
	Self	11	Self	9
	Agencies	6	Agencies	7
	Local Sponsor	2	Superiors	7
		2	OCE, BERH	3
			Misc.	2
Older Studies				
	Self	6	Agencies	6
	Agencies	4	Superiors	5
	Superiors	3	Self	4
	Local Sponsor	2	Peers	3
			Local Sponsor	2
			Misc.	2

---

*Based on first three responses to "good thing" and "bad thing" questions.

Turning to Figure 6-4, it can be seen that concern for agency coordination is the most common response for environmental specialists working on the recent studies. This is not surprising since, by and large, the responsibility for circulating EIS's for agency review has fallen on environmental specialists. In older studies concern appears to shift to being thorough and unbiased in conducting environmental studies and to mitigating adverse effects.

Figure 6-3 also contains summary statistics on the sources of praise and criticism mentioned by environmental specialists in response to the ECHO questions. In contrast to the study managers, who frequently mentioned local sponsors as sources of praise or criticism, environmental specialists frequently mention personnel in other agencies. This appears to be consistent with the interpretation discussed above that environmental specialists have the main responsibility for coordinating EIS review. What is especially noteworthy in Figure 6-3 (for both study managers and environmental specialists) is the large number of references to "self" as a source of praise and criticism. Most respondents remarked, while responding to the ECHO questions, that criticism from others was infrequent and praise from others nearly nonexistent. Although many felt their jobs to be thankless, they were able to derive self-satisfaction from work well done. This suggests that morale might be improved if study managers, environmental specialists, and their supervisors simply took a bit more time to compliment each other.

Since numerical scores were assigned to all categories and unclassified responses it was possible to score individual responses. This allowed an analytical test of the a priori hypothesis through correlation analysis and tests of difference in central tendency. The next section of this chapter discusses this analysis.

Results of Statistical Analysis

Using the median "environmental scores" assigned to the various categories, each individual ECHO response was given a numerical score from 1 to 5, higher numbers denoting greater concern for the incorporation of environmental considerations in planning decisions. Since higher scores for the dependent variables indicate a greater influence of environmental factors,

FIGURE 6-4

CATEGORIES OF ECHO VALUE RESPONSES
FOR ENVIRONMENTAL SPECIALISTS*

RECENT STUDIES

Good Things To Do	Number of Responses	Median Environmental Score
Have good agency coordination	3	3
Mitigate adverse effects	2	5
Do a thorough environmental study	2	5
Get involved earlier in the study	2	4
Have better field work	2	4
Identify all resources	2	3
Produce a good EIS	2	3
Have good coordination with planners	2	3
Include more recreation development	2	3
Bad Things To Do		
Have poor agency coordination	5	3.5**
Poor handling of EIS review	3	3
Overlook resources	2	4
Write a biased EIS	2	3
Fail to get involved with locals	2	3
Be irresponsible	2	2.5

OLDER STUDIES

Good Things To Do	Number of Responses	Median Environmental Score
Conduct thorough environmental study	5	5
Mitigate adverse effects	4	5
Include environmental features in plans	3	4
Stay on study schedule	3	2
Educate people about environment	2	4
Implement new guidelines	2	3
Bad Things To Do		
Write a biased EIS	3	3
Have inadequate field work	2	4
Have poor agency coordination	2	3.5
Poor handling of EIS review	2	3
Fail to monitor contractor carefully	2	3

---

*Based on first three responses to "good thing" and "bad thing" questions.

**Non-integer values result when median is tied between two adjacent integer values.

a significant positive correlation between the scores of the ECHO responses and the dependent variables should be taken as supportive of the a priori hypothesis. A number of different analyses were performed to test the a priori hypothesis and, in general, the results are not supportive.

One set of analyses conducted was the computation of Kendall rank-order correlation coefficients between the dependent variables and the median "environmental scores" of the first responses of study managers to both the ECHO "good thing" and "bad thing" questions. However, no significant relationships were found. Thus, to the extent that the median scores assigned to the first responses of study managers can be assumed to reflect their attitudes toward the consideration of environmental factors in planning, no support for the a priori hypothesis is evident.

In an effort to utilize more of the ECHO response data, the medians of the first two responses of study managers to both the "good thing" and "bad thing" questions were converted to 0-1 dichotomies, based on a cutpoint* of 4 (corresponding to "quite a lot" of concern for incorporating environmental factors into planning) and analyzed using the median test.** This test was made to determine whether dependent variable scores were substantially different in cases where neither of the study managers' first two responses was scored 4 or higher and cases where at least one of the first two responses was scored 4 or higher. The interpretation here is that the latter group has greater concern for including environmental factors in planning than the former.

No significant differences, in terms of either dependent variable, were found between the two groups of studies thus defined. Thus the a priori hypothesis is again rejected. The explanation for the lack of support for the a priori hypothesis shown by the ECHO data is the same as that given for the results of the Guttman scale analysis, namely, that many other influences (e.g., lack of resources, economic constraints) affect the consideration given environmental factors in planning more than individual attitudes of study managers concerning the environment.

---

*The use of cutpoints to dichotomize ordinal scales is discussed in Section 3 of Chapter 3.

**The median test, a nonparametric test of difference in central tendency, is discussed in detail in Appendix B.

Analysis similar to that described above was conducted using the environmental specialists' responses to the ECHO questions.* No significant relationships were noted in analysis of correlation coefficients between the dependent variable scores and the median scores of the first responses of environment specialists to the ECHO questions. Similarly, no statistically significant differences were found, using the median test, between studies where at least one of the first two responses of environmental specialists had a median score of 4 or higher and studies where neither first response had a score of 4 or higher. However, both formulation and modification variable scores did appear to be notably (but nonsignificantly) higher in studies where both of the first two responses of environmental specialists had scores of 3 (corresponding to "a fair amount" of concern for the incorporation of environmental factors in planning) or higher. This observation, coupled with the discussion of Section 5.3 linking environmental specialists' role perceptions to the dependent variable scores, suggests that future research should examine more closely the effects that the attitudes and motivations of environmental specialists have on the consideration given environmental factors in Corps planning.

6.3 Conclusions

Results of the analysis of relationships between study managers' attitudes and values concerning the importance of environmental factors in planning and the dependent variables uniformly indicate rejection of the *a priori* hypothesis. Neither an increased willingness on the part of study managers to forego economic benefits in favor of environmental quality, as measured by the three Guttman scales presented in Section 6.1, nor the presence of study manager values favoring the incorporation of environmental factors in planning, as measured by the ECHO value assessment discussed in Section 6.2, show significant positive relationships with the increased influence of environmental information on plan formulation or plan modification (i.e., the dependent variables).

---

*Although not a part of the *a priori* hypothesis, the possible importance of the attitudes of environmental specialists in determining the consideration given environmental factors in planning has been noted in Section 3 of Chapter 5.

> "The influence of environmental information on the formulation of alternative plans, and on the modification of a proposed plan, will be increased if new information is generated by coordination with outside agencies, groups, and citizens."

A basic assumption underlying this hypothesis is that new information generated by coordination will consist, at least in part, of information about environmental concerns. This is a reasonable assumption since many Corps coordination requirements are a response to environmental mandates and a great many participants in public involvement are motivated by environmental concern (Mazmanian and Nienaber, 1976, p. 238).

Wagner and Ortolano (1976), in a field test of an iterative planning process much like the one subsequently adopted by the Corps (OCE, 1975), found that the public involvement activities that were a part of this process led to the generation of significant amounts of new information used in the planning study. While some of the Corps planners participating in the field test considered the information generated as "old" or "known but forgotten", the results of the evaluation conducted by Wagner and Ortolano indicated that the public involvement program was effective in raising issues of concern to the local public. The "review and comment" process for EISs was found by Randolph (1976, p. 6-14) to be useful in generating new information from other agencies about direct environmental impacts but not very effective in getting information from the public. However, in a survey of Corps planners done in 1973 and 1974, Hill and Ortolano (1975, p. 6-8) found nearly half of the planners felt that, since the passage of NEPA, there had been a "moderate" or "substantial" increase in the amount or usefulness of information received from environmental or conservation interest groups. Less dramatic increases were noted for agencies and individual citizens, presumably because of prior coordination requirements. These findings all indicate that increased coordination between Corps planners and other agencies and interests has resulted in an increase in the amount of environmental information available to the Corps. This increased quantity of environmental information, coupled with the increase in the "political capital" of environmental interests brought about by NEPA (Ingram, 1973), is hypothesized to lead to a greater influence of environmental information on planning and decision making. The following

The primary reason for this lack of support for the a priori hypothesis appears to relate directly to one of the basic assumptions made at the outset of this investigation, namely, that the behavior of individual study managers would be strongly reflected in the dependent variables. In retrospect this assumption appears to have been altogether too simplistic. It ignores the influence of a great many other situational factors, such as the presence of affected environmental resources and the ability of planners to identify economically justifiable plans, as well as the influences of other individuals, notably past study managers, environmental specialists, local sponsors and planners'superiors, on the decision making process. The confounding influence of competing attitudes, such as those toward public involvement, also serves to dilute the effect of the attitudes measured in this research.

Future attempts to examine the relationship between individual attitudes and the influence of environmental factors on decision-making should differ from the approach reported on herein in at least the two following ways: 1) a careful attempt should be made to define all the attitudinal dimensions (e.g., those toward public involvement or toward work motivation, among others) which might influence the ways in which environmental information is interpreted, and 2) a rigorous attempt should be made to measure these attitudes for all the individuals (e.g., local sponsors, superiors, etc.) who might have a significant influence on decision making. Even if both these difficult tasks are accomplished, a host of other situational factors, such as the presence of affected resources, must be taken into account before a bivariate hypothesis, such as that investigated in this research, can be effectively tested.

Chapter Seven

INTERAGENCY COORDINATION AND PUBLIC INVOLVEMENT

The significance of coordination between Corps planners and other agencies and publics should not be underestimated. Long-standing regulations require support for projects by local sponsors, the need for interagency coordination was recognized as early as 1908, and the precursor to the present Fish and Wildlife Coordination Act was passed in 1934 (Ortolano, 1976). Moreover, the "review and comment" process that has evolved as part of the implementation of Sec. 102(2)(C) of NEPA requires that planners respond to comments received from other agencies and segments of the public on draft EISs.

This chapter examines aspects of this coordination with regard to its implications for the influence of environmental information on the formulation of alternative plans and the modification of a proposed plan (i.e., the dependent variables described in Chapter 4). As elaborated below, previous research was used to identify the following four areas of interest with regard to external coordination: (1) the Corps' commitment to or extent of coordination with outside agencies and publics,* (2) the effectiveness of this coordination in terms of the amount of new useful information obtained, (3) the extent to which other agencies or interests are perceived as putting pressure on Corps planners with regard to environmental issues, and (4) the extent to which other factors have acted as constraints on Corps planners' abilities to take action on comments and suggestions from other agencies and publics. The following sections discuss these topics in greater detail and analyze their relationships to the dependent variables.

7.1 Commitment to Obtaining Input

The *a priori* hypothesis regarding the commitment to obtaining external input is as follows:

---

*Publics here refers to both citizen interest groups and individuals not associated with particular groups but who might yet have an interest in a particular planning study.

> "The influence of environmental information on the formulation of alternative plans, and on the modification of a proposed plan, will be increased if the project planners exhibit a greater commitment to obtaining external input."

Hill and Ortolano (1975, p. 6-3) argue that the passage of NEPA has led to significant increases in coordination between Corps planners and conservation groups and individual citizens. In the early 1970s, as NEPA related planning guidance developed, the Corps embarked on a vigorous experiment with various public involvement techniques (Dodge, 1973). Given that environmental concern has been cited as a dominant reason for citizen participation in Corps planning (Mazmanian and Nienaber, 1976, p. 238), these observations suggest that the influence of environmental factors in planning might be enhanced by increasing the number of opportunities for information transfer between Corps planners and environmentally oriented agencies and publics. While quantity cannot assure quality, the assumption that greater opportunity for information exchange would at least help to encourage planners to consider environmental factors has been made by existing regulations and guidance. Thus, in order to put the hypothesis in a testable form, the number of opportunities for information transfer has been taken as a reflection of planners' commitment to obtaining external input.

Components of Analysis*

Study managers on both recent studies and older studies were asked to indicate the governmental agencies and interest groups with which they had had "frequent and meaningful" exchanges of information during the course of their planning studies. These were then subjectively classified (by the researcher) as "environmental" or "non-environmental", depending upon their missions and interests in the various studies. Study managers were also asked to describe any other involvement efforts, such as meetings or workshops, held with these agencies and groups, as well as with the general public. This information was then cross-checked against written records. In addition, study managers were asked to indicate the frequency of exchange of "meaningful information" with agencies, interest groups, and publics. The extent of opportunity for information transfer is assumed to be reflected in these responses. The number of environmentally oriented agencies and groups having such close coordination, the number of meetings and workshops held with them and with the general public, and the frequency of information transfer between them and Corps planners is assumed to reflect, at least partially, the Corps commitment to obtaining external input. The _a priori_ hypothesis thus requires positive association between these measures and the dependent variables.

---

*For a description of the actual interview questions used and an example of score computation refer to Appendix A, Section 4.

Another aspect of commitment to obtaining external input relates to the existence of environmental documents that are circulated for comment _before_ the draft EIS. Hill and Ortolano (1975, p. 7-12) found that half the Corps planners in their survey felt that the most useful review of environmental documents was to be obtained from circulation of a "pre-draft EIS." In case studies of Corps planning in California, Randolph (1976, p. 6-10) found that the circulation of an Environmental Working Paper, or "pre-draft EIS", tended to promote early substantive interagency coordination. Others have suggested the circulation of preliminary plans for review as a means of overcoming the "free rider problem" (Mazmanian and Nienaber, 1976, p. 238).* CEQ's proposed new regulations governing EIS's place great importance on early coordination of environmental documents as a mechanism for assuring the consideration of environmental factors in planning. These observations, and the widespread, general concern that the EIS review often occurs late in agency planning, suggest that the existence of such a "pre-draft EIS" for circulation among agencies and publics can provide another useful measure of commitment to obtaining external input.

Study managers for both recent and older studies were asked to list any documents of any type describing environmental effects of plans or projects which were circulated outside the Corps during the course of their studies. Copies of these documents were then obtained and analyzed, and their distribution among agencies and publics was determined. As the dates of completion of these documents was also obtained, it was possible to count the number, type, and distribution of pre-draft EIS documents for each planning study. If preparation and extent of distribution of such documents is taken to reflect commitment to obtaining external input, then the *a priori* hypothesis requires positive association between these measures and the dependent variables. Thus, the measure of commitment to obtaining external input is assumed to be reflected in the number of opportunities provided for face-to-face communication between planners and agencies and publics, and in the circulation of pre-draft EIS documents describing environmental effects for the purpose of generating review comments.

---

*The free rider problem is described as a situation where people have little incentive to expend resources or effort to avoid what are perceived to be insignificant individual costs, therefore "letting George do it".

Results of Statistical Analysis

Table 7-1 lists the results of rank-order correlation between various attributes of the Corps commitment to obtaining external input and the dependent variables. The correlation coefficients shown in the column labeled "formulation" support the notion that increased opportunity for information transfer, especially between planners and publics, can enhance the influence of environmental information on plan formulation. Since many of the "environmental constraints" utilized in scoring the formulation variable were, in fact, brought to the attention of Corps planners by interest groups and concerned citizens, this result should not be surprising. The data in the column labeled "modification" also suggest that the modification of authorized plans in response to environmental information is also enhanced by greater amounts of coordination with publics, especially through the format of planning workshops or seminars. (The utility of the workshop format is discussed in greater detail below.) To simplify discussion of the relationships shown in Table 7-1, the items describing the extent of coordination in each of the three broad areas (i.e., agency, interest group, and public) were aggregated to yield an overall index of coordination for each area. For example, a dichotomized version of

TABLE 7-1

EXTENT OF COMMITMENT TO OBTAINING EXTERNAL INPUT

	Dependent Variable Rank-Order Correlation Coefficients (τ) (N = 14)	
	Formulation	Modification
Agencies		
Number of environmental agencies having "close coordination"	-	-
Frequency of contact	-	-
Number of workshops or task-oriented meetings	-	-
Interest Groups		
Number of environmental groups having "close coordination"	.3357^{+}	-
Frequency of contact	-	-
Number of workshops or task-oriented meetings	.3091^{+}	.3282^{+}
Public*		
Number of formal public meetings or hearings	-	-
Number of planning workshops or seminars	.4569^{++}	.4143^{++}
Frequency of contact	.3251^{+}	-
Number of other Corps-organized presentations of project information	.3407^{+}	-

$^{+}$Significant at $p < .10$.

$^{++}$Significant at $p < .05$.

(-): no significant correlation found.

*The term public here denotes activities open to the general public in the study area but which may be attended by agency and interest group representatives.

"frequency of contact"* between Corps planners and other agencies was added to the sum of the number of environmental agencies having "close coordination" with Corps planners and the number of agency workshops or task-oriented meetings held during the study.

Table 7-2 lists the rank-order correlations between these indices and the formulation and modification dependent variables. The data in Table 7-2 suggest that the extent of agency coordination is more influential in the later stages of planning (i.e., modification) than in the earlier stages (i.e., formulation). This apparent tendency for agency

TABLE 7-2

COORDINATION INDICES

	Dependent Variable Rank-Order Correlation Coefficients (τ) (N = 14)	
	Formulation	Modification
Extent of agency coordination	-	.3126^{+}
Extent of interest group coordination	.3139^{+}	-
Extent of coordination with the public*	.5200^{++}	.3034^{+}

(-): no significant correlation found.

$^{+}$Significant at $p < .10$.

$^{++}$Significant at $p < .05$.

*The term public here denotes activities open to the general public but which may be attended by agency and interest group representatives.

---

*Originally a five-point ordinal scale, the dichotomized version of "frequency of contact" takes on a value of 0 for frequencies of "one to four times a year" or less and a value of 1 for frequencies of "five to eight times a year" or more. The rationale for dichotomizing ordinal level measurements for use in index construction is discussed in Section 3 of Chapter 3.

coordination to influence later decision points may be partly the result of regulations which do not require the review of some agencies until a draft EIS is already prepared, and partly due to the tendency of other agencies to withhold comment until Corps planners "have something to show" them. While this reluctance, which was noted in several of the interviews conducted for the research and also alluded to by Randolph (1976, p. 6-10), may be based on a desire of reviewing agencies not to expend scarce planning resources on ventures with uncertain payoffs, the data suggest that this practice of holding off until late stages causes some agencies to miss important opportunities to influence the earlier stages of planning.

The lack of a significant correlation between the interest group coordination index and the modification variable suggests that the influence of dialogue between interest groups and Corps planners may be greater in the earlier stages of planning (i.e., formulation). A similar tendency can be noted in the index characterizing coordination with the public, which is much more strongly correlated with the formulation variable than with the modification variable. This apparent trend for citizen and non-governmental group involvement to be more influential in the earlier stages of planning and agency involvement to be more influential in later stages of planning is supported by impressions gained during the field interviews. Many of the "environmental constraints" brought to the attention of planners and used in the scoring of the formulation variable were identified by concerned local citizens and groups, while it appeared that much of the impetus for the modification of plans in the older studies came from the reaction of other agencies to proposals and EISs sent out for review by the Corps. It was also noted that in several of the older studies agencies pressing for plan modifications appeared to have substantial "constituency support" from citizens groups. These observations and the correlations shown in Table 7-2 suggest that as planning progresses and proposals come nearer to being actual projects, environmentally interested citizens and groups eschew the more personal and informal dialogue of the workshop or public meeting in favor of the more legitimized and possibly more influential information channels represented by agency coordination as a means of bringing environmental values to bear on Corps decision-making. In any case, the correlations shown in Table 7-2 between the dependent variables and the index characterizing coordination with the public provide support for the argument that more extensive public involvement programs may lead to the increased influence of environmental factors in Corps planning. While these programs do not guarantee that consensus can be reached easily, especially when issues are divisive, they appear to aid in the identification of the issues of importance.

Planning Workshops

Although the role of public involvement in water resources planning is the subject of a large body of literature and public involvement has received increasing emphasis in planning regulations and guidance, the literature reflects a continuing debate over the proper and most effective formats for public involvement. The shortcomings of the traditional public hearing, which often becomes "an information process rather than a communication process" (Bishop, 1970, p. 59) has led to a search for more innovative and sensitive methods. One of the more promising of these is the planning workshop.* As part of an evaluation of a planning workshop conducted by the Corps' San Francisco District (Wagner and Ortolano, 1976), citizens indicated that communication between participants was enhanced because of the informality and the lack of authoritarianism on the part of those running the workshop. In conducting this evaluation of the workshop, Wagner relied on the model of motivation developed by Lawler and Porter (1970). This model, as interpreted by Wagner, suggests that participation of individuals in a public involvement program depends on their perception that their involvement can lead to "rewards" in terms of their having an influence on the planning process. Wagner's findings suggest that the planning workshop is perceived by citizens as providing such a "reward."

---

*The definition of the term "planning workshop" is ambiguous. Hanchey (1975, p. 13-19) describes it as a moderate-size meeting, of about 10 to 50 people, designed to encourage informed dialogue between participants and the planners. Workshops typically focus on specific areas, such as alternatives, impacts, or objectives, and are viewed as an important means of establishing personal contact between planners and interested citizens.

The extent to which the increased opportunity for communication provided by the workshop format allows the greater influence of environmental information on planning decisions was investigated as a part of the research reported on herein. While workshop formats vary a great deal, they are distinctly different from the public hearing format traditionally used in Corps studies. Descriptions of various public meetings provided by study managers who were interviewed as part of this research made it possible to classify such meetings as formal meetings, workshops, or informational presentations (e.g., a talk at a Lions' Club meeting). In addition, in some studies some of the meetings held with other agencies and interest groups were explicitly defined and intended as "planning workshops". An index indicating the extent of use of the workshop format was defined as the sum of all agency, interest group, and public workshops held during the study. This index was found to be correlated (at $p < .10$) with both the formulation variable ($\tau = .5935$) and the modification variable ($\tau = .4294$). These data suggest that the increased information flow allowed by the workshop format enhances the influence that environmental information has on plan formulation and modification. During the field interviews, several study managers indicated that they felt the workshop to be far superior to traditional public meetings provided there was adequate preparation by planners. Many of the workshops that they described relied on audio-visual aids, small group discussions, and short questionnaires to stimulate communication. The field interview comments and the statistical analysis indicate that this format for public involvement seems to be effective in overcoming many people's perceptions that their input into the planning process is not used, and that the increased information flow encouraged by the format can lead to the identification of environmental concerns in an effective way. Thorough discussions of communication techniques that can be used as part of the workshop format are widely available (see, e.g., Hanchey, 1975 and Bishop, 1970).

Pre-EIS Documents

The second aspect of commitment to obtaining external input investigated as part of this research concerned the circulation of pre-EIS planning documents as a means of identifying environmental concerns early in a planning study. While such a document is not required, information brochures and preliminary draft EISs or working papers were prepared and completed before the draft EIS in seven of the Survey Investigations and eight of the Phase I studies included in the samples. For the purposes of this research, only documents which included discussion of environmental effects and which were circulated outside the Corps* were considered in this analysis. Attributes of these documents examined included format, objectivity (e.g., did discussion address a proposed or selected plan, or did it discuss alternatives without making distinctions as to which was preferred), readability, and extent of circulation to other agencies, interest groups, and individuals.

The concept of objectivity was dropped from the analysis since all but a very few such documents, even those sent out early in the Survey Investigations, focused on specific proposals. While Randolph and Ortolano (1975, p. 5-12) suggest that this may be evidence of planners already having decided what the final plan should be before having all the information, several study managers participating in the field interviews emphasized the importance of having fairly specific proposals as a prerequisite to the generation of useful comments. As is discussed in the next section on coordination effectiveness, the dearth of new information received about new alternatives or new features suggests that greater interest and comment is generated when agencies and publics can react to suggested plans than when they are relied on to define or characterize them from the outset. This argument is clearly fallacious, however, if the planning process is unresponsive to the information received from external coordination; in such cases, the "proposed" plan is likely to become the "recommended" plan.

The readability of pre-EIS documents was measured using the Fog Index (de Voe, 1956), which assigns higher numbers to textual material having longer sentences and more extensive use of words having three or more syllables. The concept was dropped from the analysis due to an apparent lack of relationship to the dependent variables. It should be noted, however, that the indices computed were all quite high, indicating potential problems with the comprehensibility of the documents.* This finding provides some support for a point emphasized by Wagner and Ortolano (1976), who note the disadvantage of having such materials prepared for public consumption by engineers more accustomed to communicating, both within the Corps and with other agencies, on a more professional level.

---

*Such documents were circulated to other agencies, interest groups, and/or the general public.

Closely related to readability is format; the two formats used most extensively were report-style documents, similar to EISs although generally shorter, and brochure-style documents consisting of a few pages of text and, perhaps, pictures. In the eight recent studies where such brochures were utilized, formulation variable scores were substantially higher, although the difference was significant only at $p = .12$. Some study managers indicated that the more effective format for the early stages of public involvement was the brochure, but that later in the study the greater information needs of interest groups and agencies were better served by the report format.

By far the more notable findings of the analysis of pre-EIS documents concerns the more basic issues of whether such documents were prepared and how widely they were circulated. While measures of preparation and circulation showed little significant relationship with the modification variable, significant correlations were found with the formulation variable. In particular, the formulation variable was correlated positively with the number of such pre-EIS documents prepared ($p < .10$) and, more importantly, their distribution to the general public** ($p < .05$). A significant correlation was also found between the formulation variable and an index of the total distribution of such documents to agencies, interest groups, and the public*** ($p < .10$). Since pre-EIS documents were not prepared on all studies, a median test was done which showed the formulation variable scores to be significantly higher ($p < .10$) on those studies where *at least one* pre-EIS document was prepared than on studies where *none* was prepared. Similarly, median tests showed significantly higher formulation variable scores on studies where *at least one* pre-EIS document had a circulation to more than 100 individuals ($p < .05$), and where *at least one* pre-EIS document had a total distribution of more than 20 agencies *or* interest groups *or* more than 100 individuals ($p < .10$). These findings appear to support the assumption implicit in the recently proposed CEQ regulations that earlier preparation and distribution of environmental information will lead to greater consideration of environmental factors in agency planning. The use of such pre-draft EIS documents also appears to be effective in overcoming the tendency for other agencies to put off close coordination with the Corps until later stages of planning. The preparation of pre-draft EIS documents also can serve to stimulate earlier environmental study within the Corps by requiring earlier identification of impacts.

---

*According to deVoe (1956), when the Fog Index exceeds 12 there is a clear danger that the information being documented will be misunderstood. Only two of thirty documents analyzed for readability in the sample of recent studies had Fog Indices of less than 13.

**Distribution of documents to the general public (unaffiliated individuals) was measured as an ordinal scale from 1 (10 or fewer individuals) to 5 (100 or more individuals). This distribution was determined from the mailing list for each document.

***This index reflects aggregation of three ordinal scales, one reflecting agency distribution, one reflecting interest group distribution, and a third reflecting distribution to individuals (see Appendix A, Section 4).

The *a priori* hypothesis regarding the commitment to obtaining external input is supported by the findings discussed above. A greater extent of coordination, especially with publics, and the early circulation of environmental impact information documents, especially to publics, appears to enhance the influence of environmental information on plan formulation through earlier identification of environmental constraints. In addition, the extent of coordination, especially with agencies, shows a strong positive relationship to the influence of environmental information on plan modification. (This relationship is discussed further in Section 7.3 below.) Clearly, a causal relationship between commitment to coordination and the influence of environmental information on planning decisions requires the generation and receipt of environmental information as an intermediate variable. The next section discusses the effectiveness of external coordination in developing new useful information.

7.2 Generation of New Information

The *a priori* hypothesis regarding the generation of new information is as follows:

discussion elaborates on those portions of the research reported on herein that examined this relationship.

Components of Analysis*

As a part of the interviews with study managers, each respondent was asked to indicate on scales from 1 (little or none) to 5 (very much) the extent to which the comments and suggestions received from agencies, interest groups, and citizens represented new useful knowledge. This extent of newness and usefulness was investigated for information in three topic areas, namely, adverse impacts and constraints on alternatives, new ideas for features and alternatives, and preferences for features and alternatives. Respondents were also asked to indicate the degree to which information from agencies, interest groups, and citizens was perceived to be specific and constructive. It was postulated that more specific comments would impart more useful knowledge to agency planners and thereby increase the likelihood that environmental factors would receive consideration. Similarly, comments perceived as constructive were postulated to be more useful to Corps planners than those which were merely critical** of the Corps.

The response patterns to the questions regarding new information showed that for both recent and older studies relatively little new information was gained in the area of new ideas for features and alternatives. This is consistent with remarks made by several of the study managers interviewed that more effective dialogue in public involvement occurs when participants can react to the proposals and suggestions of planners rather than when the participants are relied on to generate their own alternative proposals. These generally low values and a notable lack of variance in the items describing new information on ideas for features and alternatives led to their being dropped from subsequent analysis.

---

*For a description of the actual interview questions used and an example of score computation refer to Appendix A, Section 4.

**The perception of Corps planners that outside groups and citizens are generally hostile to their proposals has been noted by Hill (1977, p. 128) and Nienaber (1975, p. 32).

Generally greater amounts of new knowledge were gained in both recent and older studies in the areas of adverse impacts and constraints and preferences for features and alternatives. In the sample of recent studies, all three sources (i.e., agencies, interest groups, and citizens) were perceived to provide relatively equal amounts of new knowledge in both these topic areas, while in the sample of older studies agencies and interest groups were perceived to provide somewhat greater amounts of new knowledge than citizens. Preliminary analysis showed no notable relationships between the dependent variables and items pertaining to new knowledge about preferences, however, and these variables were dropped from further analysis leaving only variables describing the extent of new knowledge concerning constraints and adverse impacts as the focus of analysis.

Results of Statistical Analysis

Significant positive correlations were found between the formulation variable and the perceived amount of new knowledge concerning adverse impacts gained from interest groups ($p < .10$) and citizens ($p < .05$). This result should not be surprising since, as mentioned previously, many of the "environmental constraints" used in scoring the formulation variable were brought to the attention of planners by interest groups and concerned citizens. While no significant correlations were found between the modification variable and the items pertaining to adverse impact information, the modification variable was found to be significantly correlated with the perceived amount of new knowledge concerning constraints on alternatives gained from citizens ($p < .10$), interest groups ($p < .10$), and agencies ($p < .01$).* These findings lend support to the notion that information concerning the adverse environmental effects of proposals provides a major impetus for the consideration of environmental factors in planning and suggests that the following, more specifically worded version of the *a priori* hypothesis may be worthy of testing:

---

*One possible explanation for this apparent shift in emphasis from "adverse impacts" in the recent studies to "constraints" in the older studies may be that in the latter, where a Congressionally authorized plan exists, planners perceive information on adverse environmental effects to be more explicitly linked to specific features of plans than is the case in recent studies. In any case, the correlations between both the adverse impact and constraint items and the dependent variables are corroborated by strong positive correlations between the formulation and modification variables and the perceived degree of influence of other agencies, interest groups, and local publics on the fundamental planning task of impact assessment. (The variables characterizing perceived influence on fundamental planning tasks are introduced in Chapter 5, Section 2 and are further discussed in Appendix A, Section 6.)

> "The influence of environmental information on the formulation of alternative plans, and the modification of a proposed plan, will be increased if greater amounts of that information represent new knowledge concerning the potentially adverse effects of the plan(s)."

The perceived amounts of new information concerning adverse effects also shows strong positive associations with the extent of coordination variables presented in Section 7.1, indicating that greater amounts of coordination may lead to identification of these adverse effects. Multivariate relationships such as this will be discussed in greater detail in Section 7.5.

Another observation can be made regarding the data concerning new information. The apparent tendency for agencies and interest groups to be viewed as greater sources of new information than individual citizens in the older studies suggests that as planning progresses planners are more receptive to sources of information having greater perceived political significance (Ingram, 1973, p. 163). While local sponsors must, of course, provide assurances of support, interest groups can cause costly delays through litigation and agencies, tending to take more critical views now than in the past, may feel that the payoffs of "mutual accommodation" with the Corps are less than obvious (Ingram, 1972). Thus the "political capital" of information sources may, at least in older studies, determine the perceived "usefulness" of information obtained from them. This interpretation appears to be supported by the *strong* correlation noted between the modification variable and new information from agencies concerning constraints on alternatives and the *lack* of a significant correlation between the formulation variable and new information from agencies concerning adverse effects.

Specificity and Constructiveness

In the sample of recent studies, comments and suggestions from individuals and interest groups were viewed as being more specific than those from agencies, while in the sample of older studies, agency and interest group remarks were seen as most specific. The increase in perceived specificity of agency inputs in the older studies may reflect the aforementioned tendency for agencies to withhold comment until proposals themselves are more specific, often reserving comment until review of the draft EIS. In the sample of recent studies, the types of information perceived as most specific were those items pertaining to information on constraints and adverse effects from interest groups and to a lesser extent from individual citizens. In the sample of older studies, information of all types was generally perceived as quite specific; the specificity of these comments was probably a reflection of the existence of an authorized plan.

A significant positive correlation was found between the perceived specificity of information from interest groups and the formulation variable ($p < .05$). This finding, coupled with the observation that many "environmental constraints" used in scoring the formulation variable were identified by interest groups, suggests that the increased consideration given environmental factors in the early stages of planning is significantly influenced by the role that interest groups take in precisely identifying possible adverse effects and in presenting that information to planners in as "factual" a format as possible.

In the sample of older studies, a significant correlation was found between the perceived degree of specificity of agency information and the modification variable ($p < .10$). While this is to some degree reflective of increasing agency involvement in planning as the planning itself becomes more specific, it supports the notion advanced above that in the later stages of planning the "political capital" of coordinating agencies can be used effectively to bring about modifications that reflect the reviewing agencies concern for specific environmental issues. It appears, however, that the practice of non-involvement by many agencies until the later stages of planning,* noted earlier, may hinder environmental and conservation agencies from influencing the types of alternatives considered and represents a foregone opportunity in that respect.

---

*Ingram suggests that a lack of adequate resources in the agencies is partly responsible for the practice of withholding a thorough review of water resources development agency proposals until the later stages of planning (1973, p. 160).

In both samples, the perceptions of constructiveness of new information received lower scores (on 5 point scales) than the perceptions of specificity, with the majority of the respondents indicating that less than half of the new information (from all sources) was constructive. The perception of constructiveness appears to be highly related to the "tone" with which new information is offered. Hill and Ortolano (1975, p. 6-9) found that many planners perceive criticism of plans or impact statements not to be "useful input". In the sample of recent studies, a significant negative correlation was found between the perceived degree of criticism from interest groups and the constructiveness of information received from those groups ($p < .10$). Thus criticism is clearly not viewed as constructive information in the early stages of planning. In the sample of older studies, no relationship was found between these two concepts.

There is a notable absence of a relationship between the perception of constructiveness and the dependent variables in the sample of newer studies; this absence suggests that the information perceived as constructive is not the information which leads to the increased influence of environmental factors in the early stages of planning. For example, impact information from groups and citizens, which was positively correlated with the formulation variable, showed a negative relationship to perceptions of constructiveness in the sample of recent studies. This finding further supports the notion that it may be the political significance of the information source more than the content of the information which determines the perceived "usefulness" of new information.

In the sample of older studies, this apparent relationship between political significance and constructiveness is less apparent. A significant correlation was found between the modification variable and the perceived degree of constructiveness of agency information ($p < .05$). It appears that once agency input is obtained, it is generally viewed as constructive (perhaps as a result of the policy of mutual accommodation among agencies noted by Ingram) and can be influential in effecting project modifications in response to environmental issues.

Overall, the effectiveness of external coordination in terms of the generation and utilization of new information in survey scope investigations seems to lie in the ability of such coordination activities to identify adverse effects important to local citizens and interest groups in the early stages of planning. In the later stages of planning, e.g., during the Phase I GDM process, conservation agencies take on a more important role as sources of such information. In both cases the degree of specificity of the information received appears to be important in its utilization, with more specific information being more effectively used. The perception of constructiveness of information appears to depend more on its tone that its contents, suggesting that the perceived political significance of the information source, in terms of its ability to disrupt the planning process, is a greater determinant of the utility of information. The extent to which various entities can and do exert pressure on Corps planners is discussed further in the section below.

7.3 Perception of Pressure

The a priori hypothesis regarding perceived pressure is as follows:

> "The influence of environmental information on the formulation of alternative plans, and on the modification of a proposed plan, will be increased if the level of pressure from other agencies, groups, and individuals on the District office doing the planning is increased."

For the purposes of this research, the level of pressure on the District office refers to the perception on the part of planners that there is more or less than the usual or normal amount of interest, criticism, or controversy in their studies regarding environmental issues. The rationale for the hypothesis is that the increase in litigation and project delay resulting from court rulings on procedural aspects of NEPA and its offspring regulations has resulted in a "learning" process (Randolph, 1976, p. 6-12), whereby planners are more responsive to environmental issues presenting even the threat of litigation. Mazmanian and Nienaber (1976, p. 245) assert that political support for change and pressure from affected interests are essential to bring about the organizational change necessitated by NEPA and the Corps commitment to public participation. Hill and Ortolano (1975, p. 7-4) also offer the threat of litigation as an explanation of why there has been the increased consideration given to conservation agency comments obtained through the EIS review and comment process. While regulations require Corps planners to conduct public involvement and agency coordination procedures, and probably best explain the increased extent of coordination with agencies and segments of the public, the present research investigates the role which a more subjective perception of pressure has in the consideration given environmental factors in the planning process.

Components of Analysis*

As a part of the interviews conducted as part of this research, each study manager was asked to indicate on an ordinal scale the degree to which each of nine items had departed from his expectations or perceptions of the norm, regarding environmental aspects of his planning study. The nine items (hereinafter referred to as "pressure items") included level of controversy, local interest and criticism from the local public, from interest groups, from agencies, and from Congressional respresentatives. Also included were items relating to the extent of agency coordination and pressure from superiors in the Corps hierarchy and from other high-ranking officials. The study managers were also asked whether a significant threat of litigation existed, who the plaintiffs would be, and what the issues would be. In three of the recent studies and five of the older studies, study managers perceived a significant threat of litigation. At the time of the interviews, however, none of the cases were actually in the courts.** The _a priori_ hypothesis, asserting an association between level of pressure and the influence of environmental information, would be supported by positive correlations and tests of significance between the responses to the questions concerning the aforementioned nine items and the dependent variables.

---

*For a description of the actual interview questions used and an example of score computation refer to Appendix A, Section 4.

**The threat of litigation did result, however, in one "conditional authorization" in the sample of older studies, requiring resolution of an environmental issue through use of an interagency task force.

Results of Statistical Analysis

The distribution of responses to the nine pressure items reveals a substantially greater amount of perceived controversy and criticism in the sample of older studies. This is most likely the result of the fact that studies in this population all address a very specific and well-defined project that is much closer to actual construction than proposals in the Survey Investigation stages of planning.* The existence of a proposed plan provides a focus for attention of environmentally concerned citizens and the late stage provides a motivation for involvement since "time is running out!"

In the sample of recent studies, no statistically significant correlations were found between the formulation variable and any of the nine items relating to pressure. These findings suggest that controversy may be more difficult to generate at earlier stages in planning and that even if criticism exists, it may be relatively ineffective in determining the types of alternatives that are to be considered. As is noted by the findings in Secs. 7.1 and 7.2 above, a more "professional tone" emphasizing the factual nature of adverse project effects seems to have a greater influence than criticism when it comes to formulating alternatives.

The effects of controversy and criticism are much more notable in the sample of older studies. Significant positive correlations were found between the modification variable and the perceived levels of local interest, local criticism, and interest group criticism (all at $p < .05$). In addition, strong positive but nonsignificant relationships were found between the modification variable and the perceived levels of Congressional criticism and controversy generally. Modification scores were also substantially higher in the five studies where there was a perceived threat of litigation but the difference was significant, using the median test, only at $p = .15$. These findings clearly indicate the importance of political pressure in influencing the modification of projects in response to environmental issues. Because the items concerning controversy, local interest and criticism, interest group criticism, and Congressional criticism were found to be highly inter-related, an index was constructed reflecting the existence of environmental concern as a local issue.* As might be expected, this index showed a significant ($p < .05$) correlation with the modification variable as well.

---

*Inasmuch as the older studies represent situations where most pre-authorization planning was carried out before the implementation of NEPA procedures, this increased controversy may also reflect the fact that relatively little environmental information was considered before the onset of Phase I planning.

The generally low levels of controversy and criticism in the sample of recent studies and the strong association between modification and environmental controversy in the sample of older studies indicate that pressures exerted on planners by environmental interests increase as proposals having significant impacts come nearer to construction. This suggests two avenues by which environmental interests may influence Corps planning. The first, public education, involves the identification of potential impacts and education of local citizens and decision makers about them. If planners do not perceive these impacts to be important to a sufficiently large portion of the populace they may not be taken into account when formulating alternatives. The second avenue of influence, late-stage controversy and litigation, also appears to be an effective means of altering proposals to reflect environmental concerns.

Another finding from the bivariate analysis of the nine pressure items was a strong negative relationship between perceived environmental pressure from the members of the Corps hierarchy and the formulation variable. Recall from the discussion in Section 1 of Chapter 5 that, in several of the recent studies, study managers perceived that the District hierarchy, particularly the District Engineer, had exerted a dominant influence over the consideration given environmental factors. The negative correlation between hierarchy pressure and formulation further supports the notion that the influence of environmental information on planning decisions can be suppressed by the intervention of the values and preferences of the study managers' superiors. Mazmanian and Nienaber (1976, p. 232) found many District Engineers viewing public participation programs as a special channel of communication for environmental interests only and not the best way to reach "the public" as they perceived it. These findings suggest that if the District hierarchy, particularly the District Engineers, take such a limited view of public involvement, their notion of what is in the public interest may be contrary to the value and preference information resulting from public involvement efforts.

---

*The importance of interest groups in raising environmental issues is highlighted by a strong positive association between the local issue index and the perceived influence of interest groups on the four fundamental planning tasks of problem definition, alternative formulation, impact assessment, and plan selection. (The variables characterizing perceived influence on fundamental planning tasks are introduced in Chapter 5, Section 2 and are further discussed in Appendix A, Section 6.)

The findings of the analysis of the nine pressure items clearly indicate that environmental modifications can be brought about in older studies by the presence of environmental concerns as a controversial issue. The data suggest that the pressure exerted by a coalition of interest groups and conservation agencies* is often sufficient to induce modifications in the form of major design changes, as well as smaller mitigating features.** Controversy and the threat of litigation appear to have little or no influence, however, on the formulation of plans. Other factors, among them the leadership of members of the District hierarchy, may be more potent predictors of plan formulation. The effects of hierarchy constraints and other factors inhibiting response to external input are examined further in the next section.

7.4 Responsiveness to External Input

The a priori hypothesis regarding responsiveness is as follows:

> "The influence of environmental information on the formulation of alternative plans, and on the modification to a proposed plan, will be increased if planners have a greater ability to be responsive to external input."

Responsiveness to external input refers to the degree to which planners feel uninhibited by institutional, political, and other factors from responding to and acting upon the comments and suggestions received in coordinating with other agencies, interest groups, and citizens. Several of these institutional and political factors included in this research have been identified by others as being influential in determining the effectiveness of NEPA-related coordination. Hill and Ortolano (1975, p. 8-4) found that resource constraints in terms of manpower, time, and expertise, may be significant obstacles to the effectiveness of the review and comment process of NEPA. This occurred because manpower ceilings were in effect when NEPA was passed and the increased workload involved in preparing and reviewing EISs was not accompanied by large increases in staffing. More generally, while NEPA prescribes substantial executive duties, it does not include any appropriations for carrying them out.* These observations suggest that a lack of adequate funding and manpower may be significant constraints on planners' ability to respond to information and requests from outside the Corps. Ingram (1973, p. 162) notes that although NEPA prescribes many changes in the formal procedure of agency decision-making, the inertia of past experience makes it unreasonable to expect decision-makers generally to conceive problems in ways substantially different from those of the past. Where an organization is dominated by a very few disciplines (such as is the Corps by engineers) this resistance to change is more pronounced. These observations suggest that a major constraint on the responsiveness of planners to external input may be their perception that suggestions proffered by agencies and publics are outside their authority, are irrelevant, or do not address the planners' perception of the problem. Still more constraints may be imposed on planners by their superiors in the Corps hierarchy. Given the extensive review which is a part of every planning study, members of the hierarchy at the District, Division and OCE levels all may substantially influence decision-making. These findings, along with observations made during interview pretesting suggested eleven factors which might significantly inhibit the response of planners to information obtained through external coordination.

---

*This relationship is further examined in Section 7.5.

**Observe, however, that none of the projects in the sample of older studies had been declared inactive as a result of environmental considerations.

Components of Analysis**

As a part of the actual field interviews, study managers were asked to indicate on a scale of 1 (no constraint) to 5 (severe constraint) the extent to which each of eleven factors had inhibited their ability to be responsive to comments and suggestions obtained from other agencies, interest groups, and citizens. These eleven items, hereinafter referred to as the "responsiveness items", addressed the following factors as constraints: overall planning authority, scope of authorizing legislation, existence of other plans and agreements requiring compliance, preferences of District, Division, and OCE superiors, levels of funding, availability of manpower and needed expertise, the political climate of the study, and the degree to which comments and suggestions are perceived as not being relevant to the problems and needs under study.

---

*Given the lack of debate and ease with which NEPA was enacted by Congress, it is possible that many legislators did not understand fully the implications of Sec. 102(2)(C), the "action-forcing" provision of the act, and did not anticipate the need for manpower and funding.

**For a description of the actual interview questions used and an example of score computation refer to Appendix A, Section 4.

Overall planning authority and available manpower stood out as significant constraints in both recent and older planning studies; in addition, funding was perceived as a dominant constraint in many of the recent studies. The planning authority constraint suggests that many planners view comments and suggestions from other agencies and publics as requests for actions which they are not authorized to undertake. An example of this is a request by others for non-structural flood control measures. Although the non-structural solution was considered as an alternative in four of the seven flood control studies in the sample of Survey Investigations, some study managers indicated that this was essentially a routine procedure to satisfy their regulations rather than serious consideration of non-structural measures as a solution.* The reasons cited were that the urbanized nature of the basins precluded non-structural solutions or that the Corps had no authority to implement them. In two of the recent studies examined as a part of this research a negative report or recommendation of no Federal action was filed. However, in neither case was the desire to implement non-structural measures the principal reason for the negative report. An interesting explanation of the apparent reluctance of Corps planners to recommend solutions that are outside the Corp's implementing authority was provided by three study managers (all in different Districts) who remarked that their job advancement opportunities and those of their superiors were contingent to some degree upon the number of "favorable reports" they produced (i.e., reports recommending an action the Corps could implement). If this is generally the case, then it represents a major obstacle to the serious consideration of nonstructural alternatives and other measures that the Corps is not authorized to implement.

---

*In one study, in a rural area, zoning and land use controls represented perhaps the best solution to future flooding problems; however, no local or regional governmental entity had the authority to implement them and a "negative report" was filed. Observe, further, that a lack of serious consideration of non-structural solutions was also found in the survey of Corps planners conducted by Hill and Ortolano (1978).

The emphasis given to manpower and funding constraints is consistent with earlier research findings (e.g., Hill and Ortolano) that resource constraints may be a significant barrier to the effective implementation of NEPA. It is interesting to note that studies where these resources were viewed as the greatest constraint were studies from Districts where there appeared to be the greatest enthusiasm and leadership for environmental planning. A possible explanation for this is that in those Districts the general expectations of planners for resources with which to conduct public involvement and interagency coordination are higher, leading to a greater cognizance of the importance of and need for these resources. In any case, it appears that a significant portion of the comments received from outside the Corps relate to requests for more elaborate analysis or coordination and/or represent desires for actions which Corps planners do not feel authorized to undertake.

Since the responsiveness items were scored from 1 (no constraint) to 5 (severe constraint), the _a priori_ hypothesis would be supported if _high_ scores on the dependent variables were associated with _low_ scores on the independent variables. In other words, _negative_ bivariate correlations would be expected if the _a priori_ hypothesis is true.

Results of Statistical Analysis

Examination of bivariate correlations between the eleven responsiveness items and the dependent variables shows relatively little clear support for the _a priori_ hypothesis. The only significant negative correlation noted was between the modification variable and the perceived extent of constraint imposed by authorizing legislation. This suggests that planners may, to some extent, be reluctant to modify plans in light of environmental issues once those plans have the stamp of Congressional approval.

Contrary to what would be expected if the a priori hypothesis were true, positive correlations were found between the formulation and modification variables and the perceived degree of funding constraints ($p < .10$). A possible explanation for this result is that in studies having high scores on both dependent variables (i.e., formulation and modification) environmental concerns were more pronounced and a greater need was in evidence for environmental study and/or coordination with other agencies and publics. This "demand" for the attention of planners to environmental concerns could then lead those planners to feel underfunded.

The most interesting results of the statistical analysis, however, relate to correlations between the dependent variables and indices formed from subsets of the responsiveness items. Two indices were constructed reflecting the extent of resource constraints and hierarchy constraints. The former was composed of the items relating to funding, manpower, and expertise and the latter to the preferences of Corps superiors at the District, Division, and Washington levels. The resource constraint index showed a significant positive correlation with the formulation variable ($p < .05$) and a strong but non-significant positive correlation with the modification variable. These correlations tend to support the notion advanced above that in studies where environmental concerns are more substantial (i.e., where more environmental constraints are in evidence and where more environmental modifications are contemplated) planners tend to feel that more money and manpower are needed to fully address those issues.

A significant negative correlation supporting the a priori hypothesis was found between the hierarchy constraint index and the formulation variable ($p < .05$) suggesting that the planning hierarchy may be less receptive to the accommodation of environmental issues than are the "front-line" planners. The role of the hierarchy has been noted above, in Section 7.3, as being potentially influential in determining the consideration given to environmental factors in the survey stage of planning. The negative correlation reported here further suggests that leadership from superiors plays a very important role in determining what types of alternatives are to be considered and the weight to be given environmental considerations in Survey Investigations. The negative sign of the correlation also suggests that one effect of increased hierarchical control over the response of study managers to external inputs may be to reduce the degree of consideration given environmental factors in planning.

7.5 Multi-Variate Relationships

Given the importance of external coordination in the Corps planning process, it is of interest to examine the relationships between some of the independent variable concepts discussed in this chapter. The goal of such a discussion is to clarify the structure of the coordination process and to provide the basis for a behavioral model of the process that might be subject to testing in later research. As discussed in Chapters 2 and 4, the planning process at the Survey Investigation stage exhibits a greater degree of individualism than at the Phase I planning stage. This is due primarily to the greater degree of uncertainty concerning technical, economic, political and environmental factors present in earlier stages. As a result, it is more difficult to characterize the process of external coordination at this stage in general terms. Perhaps the most important finding of the present chapter relating to recent studies concerns the role of interest groups in identifying environmental constraints in the early stages of planning, as discussed in Section 7.2. A model characterizing this process is described in the first part of this section.

In the Phase I planning process issues appear to be sharply defined, specific proposals and their associated impacts have been identified, and the resulting decrease in uncertainty regarding both technical and institutional factors leads to more easily generalizable structuring of the coordination process. The increased importance of agencies at this stage, as discussed in Section 7.1, is perhaps the most significant finding of the current chapter with regard to these studies. A model describing the agency involvement process is discussed in the second part of this section.

The statistical technique which was relied on heavily in this section is partial correlation. Discussed in greater detail in Appendix B, partial correlation analysis provides the researcher with a single measure of association between two variables while adjusting for the effects of one or more additional "control" variables. This procedure might be used, for example, to analyze the effect of age (the "control" variable) on the relationship between education and income. The partial correlation coefficient is the bivariate correlation between two variables with the linear effects of a third variable "removed." It is particularly useful in uncovering spurious and intervening relationships between variables. If the correlation between two variables is increased when the effects of a third "control" variable are "removed", the control variable can be thought of as suppressing the correlation between the two original variables. If, on the other hand, the original correlation is reduced, the control variable can be thought of as an intervening variable in the original relationship. While the Kendall rank-order correlation coefficient has been generalized to a partial, no test of significances is presently available. As a result, the analysis presented herein must be viewed only as an attempt to identify trends in the data, and not as "proof" in any sense.

Interest Groups and Identification of Potential Impacts

Of all the environmental constraints and objectives identified in the scoring the formulation variable for all recent studies, 11 of 24 were brought to the attention of planners by concerned individuals and interest groups.* These objectives and constraints were usually based on a concern over possible adverse impacts. To determine if the information obtained from interest groups and individuals concerning adverse effects, discussed in Section 7.2, was an intervening variable between the measures of the extent of public involvement, discussed in Section 7.1, and the formulation variable, the effects of this information were "removed" statistically (using partial correlation) from the extent of public involvement-formulation variable relationship. The degree of correlation between the extent of public involvement and the formulation variable was reduced substantially when the effects of the variables describing impact information from interest groups and citizens were "removed" suggesting that information concerning adverse impacts from groups and citizens does provide a link between

---

*These interest groups ranged from strictly local organizations to those, like the Sierra Club, that had a national headquarters and members across the country.

the act of obtaining input (i.e., public involvement) and its utilization (i.e., the formulation variable). The fact that the relationship did not disappear (i.e., the bivariate correlation between the extent of public involvement and the formulation variable was not reduced to zero) indicates that other factors also influence the relationship. One of these factors appears to be the degree to which study managers believe that adverse effects identified by special interests are important to a broader segment of the population in the study area. This notion is supported by the great emphasis on public involvement found in the ECHO value assessment questions and from informal remarks by several study managers to the effect that "the public will get what it wants" from the study. The strong (but non-significant) relationship between the formulation variable and the index reflecting environmental concern as a local issue (discussed in Section 7.2) give further evidence that mere identification of impacts may not be sufficient, but that the raising of the general level of awareness of them among the public is also very important. The formulation variable scores were found to be significantly higher ($p < .05$), using the median test, in those recent studies where study managers perceived at least one of the environmental objectives or constraints used in scoring the formulation variable to have had importance to the general public in the study area.

These findings suggest that the influence of environmental information on plan formulation can be greatly enhanced when an active public involvement program is supported by environmental interest groups who can identify potential adverse effects and bring them to the attention of planners in a "factual" context and at the same time increase general awareness of those impacts among the public so that their widespread importance is obvious to planners. It should be recalled from the discussion of Section 7.3, however, that the "public interest", as perceived by the District hierarchy, may be substantially different from that of the study manager and can greatly influence the consideration given environmental factors in Survey Investigations.

Agencies and the Resolution of Environmental Controversy

Ingram (1972) has characterized two of the decision rules associated with water resources planning in the past in terms of "mutual accommodation" and "noninterference". According to Ingram, conservation agencies have tended to advocate rather than oppose projects in order to achieve narrow political ends and generally have not involved themselves in planning studies in which they do not have a direct interest. She argues that the passage of NEPA and related environmental mandates has upset these decision rules and resulted in more conservation agency opposition to and questioning of water resources projects. The findings of Section 7.1 clearly indicate that agency involvement is strongly associated with project modifications made in response to environmental issues. The findings of Section 7.3 also suggest that controversy over environmental issues often leads to major project modifications. The changes that Ingram asserts NEPA has caused in the two aforementioned decision rules suggest that this agency involvement and environmental controversy are related. In the field interviews conducted as part of this research it was noted that many of the changes addressed by the modification variable were either suggested by other agencies or were "adopted" by other agencies after interest groups had made an issue of them. This observation, coupled with Ingram's interpretation of NEPA's effect on these decision rules, suggests a process whereby conservation agencies, feeling pressure from their own constituencies, assume a role of advocate of those environmental issues in dealing with the Corps during the Phase I GDM stages of planning. Thus these agencies provide a more "official" mouthpiece for the expression of environmental concern, one that may have more political leverage.* To see if this interpretation could be supported statistically the effects of agency involvement were "removed" (using partial correlation) from the local issue index-modification variable relationship. As a result, the correlation between controversy and modification was reduced to near zero, providing support for the notion that agencies can act as powerful environmental advocates if they feel that such action is supported by their constituencies. This implies that in later stages of planning, environmental groups may effect project modifications by enlisting the support of conservation agencies. This is not to say that environmental groups themselves do not have the political capital to do this without agency support. However, the legal mandates for agency coordination provide a highly legitimized and well-defined channel for pressure from environmental interests.

---

*Although conservation agencies have no official veto power over Corps projects, a negative reaction on their part can result in proposals being withdrawn (Ingram, 1972, p. 103).

The findings of this section point out two avenues by which environmental interest groups may be able to influence the Corps planning process. The first, which seems to be more effective in influencing the formulation of plans, involves the education of local publics regarding the potential adverse effects of projects. The second, which seems to be more effective in later stages of planning, involves the development of environmental controversy and enlisting the assistance of conservation agencies as advocates. While the latter may be more cost-effective in terms of human resources required from interest groups, it connotes reactive rather than active learning, and the lesson learned from litigation in the late stages of planning can only be applied to later studies. The public education avenue of influence, where environmental concerns influence some of the goals of the planning process, connotes a more positive approach. Whether the long-term outcomes of these two different approaches are the same is debatable. The next chapter specifically investigates whether earlier identification and study of environmental issues enhances the influence of those issues in the plan formulation process.

Chapter Eight

TIMING OF ENVIRONMENTAL COORDINATION AND STUDY

Preceding chapters have discussed District office planning procedures, interagency coordination, and public involvement and the influence of these procedures and activities in determining the degree of consideration given environmental factors in decision making. An aspect of these various activities which is of fundamental importance, but which has not yet been addressed, relates to the timing of their occurrence in the planning process. This chapter investigates explicitly the relationship between the dependent variables and the timing of external coordination and environmental data gathering. As regards external coordination, the discussion concerns the timing of information transfer from other agencies and interest groups and the occurrence of public involvement efforts. As regards information gathering, the discussion concerns the timing of field work, literature review, environmental document preparation and Environmental Quality (EQ) planning.* The analysis below compares the timing of these activities to two key decision-making points in the Survey Investigation planning process, namely, the point at which planners first feel that a consensus has been reached regarding the most desirable course of action and the point at which a particular alternative is first officially referred to as the "proposed" plan.

Since an authorized plan exists from the outset of a Phase I planning study (i.e., one of the "older" studies), the comparison of timing of external coordination and information gathering activity to the two decision points mentioned above would be meaningless. As a result, the analysis in this chapter focuses only on the sample of Survey Investigations ("recent" studies) and the formulation dependent variable.**

---

*As discussed above in Section 1 of Chapter 2, the identification of an EQ plan is required, where feasible, by Corps guidance in response to the Water Resources Council's 1973 "Principles and Standards".

**The decision to examine timing issues only for recent studies appears to have been a correct one since in only one of the "older" studies did the final plan differ radically in form from the Congressionally authorized plan, although several involved substantial modification in the form of site changes (see Section 4 of Chapter 4).

8.1 Timing of Agency and Public Involvement

The _a priori_ hypotheses regarding timing of external coordination are as follows:

> "The influence of environmental information on the formulation of alternative plans will be increased if there is increased involvement of other agencies, groups, and citizens _before_ the study manager develops a preference for a specific alternative and _before_ the agency tentatively selects a proposed plan."

The late stage at which NEPA's "review and comment" (R&C) process occurs has been often cited as an obstacle to its effectiveness. Hill and Ortolano (1975, p. 7-12) found that only a fourth of the Corps planners surveyed by them felt the comments received on draft EISs represented the most useful review. In fact, half the planners felt the most useful review was to be obtained from documents circulated even _before a preliminary draft EIS_. This clearly indicates the high value that Corps planners themselves place on the early timing of input from other agencies and publics. Anderson (1973) also argues in favor of early involvement of agencies and publics; he asserts that the success of the "action forcing provision" (Sec. 102) of NEPA is intended to be measured by the degree to which it forces Federal planners "to take environmental factors into account at the moment they begin to formulate their ideas and proposals". The Council on Environmental Quality (CEQ) also favors the early involvement of agencies and publics and the early development of environmental information in its latest proposed regulations; these regulations place great emphasis on the timing of environmental assessments (CEQ, 1978). All these observations point to the importance of involving agencies and publics at the earliest stages of planning if the goals of NEPA are to be met. This section analyzes the relationship between this early involvement and the formulation dependent variable measured for recent studies.

Components of Analysis*

As a part of the field office interviews, study managers were asked to name the agencies and interest groups with which they had had "frequent and meaningful" exchanges of information during the course of their studies. For each, the date (to the nearest month) and nature of the first "substantive" information transfer was obtained. In addition, the dates of any workshops or seminars held and the dates of formation of any agency or group task forces or advisory committees were ascertained. Study managers were also asked to describe their public involvement programs, giving the dates of all public meetings and workshops as well as dates of formation of any citizens advisory committees.

---

*For a description of the actual interview questions used and an example of score computation refer to Appendix A, Section 5.

In order to evaluate the timing of these events in the planning process, a further series of questions was asked to ascertain when study managers felt that a consensus had first been reached by the District planners and hierarchy and the local sponsor regarding the "most desirable" alternative plan of action. The "date of office consensus" (DOC) was obtained from the above line of questioning.* While no archival verification of the dates given as DOCs was obtainable, the study managers fully understood the questions and appeared to be quite candid in answering them. The DOCs obtained ranged from 9 months to 3 years earlier than the dates of official recommendation of specific proposals.** An additional series of questions was asked to ascertain the date at which a specific alternative plan had first been tentatively referred to as the "proposed" plan. This typically occurred at a checkpoint conference between District planners and Division reviewers, although in a few cases it occurred at a conference with local sponsors. These dates referred to as the dates of tentative selection (DTS) ranged from 4 months to 2-1/2 years earlier than the dates of official recommendation of specific proposals. The DOCs ranged from 3 months to 2 years earlier than the DTSs. It is interesting to note that most of the studies having the earliest DOCs are found in Districts where the interviewer perceived (and the organizational design data in Chapter 5 above indicate) the lowest managerial or leadership commitment to environmental planning. It may be that in those Districts, planners and their superiors have professional biases which lead them to conclude at an early stage what course of action they perceive to be in the "public interest."

---

*Randolph and Ortolano (1975, p. 5-7) argue that the tentative selection of an alternative by the study manager at an early stage of planning forecloses the serious consideration of other alternatives.

**This date of official recommendation was assumed to be represented by the date at which the Draft Feasibility Report was sent for Division-level review, i.e., "milestone 7" in the preauthorization planning process.

The scoring procedure for the data concerning timing of involvement of other agencies and publics is based on comparing the dates of substantive information transfer, meetings, workshops, and committee or task force formation with the DOCs and DTSs described above. Variables reflecting early agency, interest group, and public involvement were defined as simple counts of the numbers of the relevant events (e.g., meetings, etc.) which occurred _before_ the DOC and _before_ the DTS; for each type of involvement, two variables were thus constructed, one using the DOC as the counting cutoff and the other using the DTS as the counting cutoff. Events occurring after any one of these two dates were not counted in the score for that date. Thus the timing variables discussed below take on higher integer values* when a greater number of agency and public contacts and activities occurred _before_ the development of office consensus and tentative selection. The index obtained using the DOC as a cutoff date is thus assumed to represent the extent of coordination and public involvement activity undertaken while a _range_ of alternatives were receiving relatively equal attention and preferences for a particular proposal had not yet been formed. The index obtained using the DTS as a cutoff date is assumed to represent the extent of coordination and public involvement activity undertaken before planners and their superiors focus all their attention on a single proposal, relegating other alternatives to the alternatives section of the EIS.** The _a priori_ hypotheses thus require positive associations between these values and the formulation dependent variable.

---

*As this procedure may bias against studies having a smaller total number of such contacts or activities, a second set of variables were defined by dividing the integer values thus obtained by the total number of those activities for each study, yielding a _percentage_ of activity occurring before the DOC and DTS, respectively. However, subsequent analysis showed no significant differences in the rank-order of studies using either scoring method and the latter was dropped from further analysis. In any case, an argument could be made that the latter normalizing procedure gives undue credit for a _lack_ of agency and public involvement.

**NEPA requires in Sec. 102(2)(C) that the EIS discuss "alternatives to the proposed action".

Results of Analysis

Table 8-1 gives rank-order correlation coefficients between various aspects of agency and public involvement using the two cutoff dates (DOC and DTS) and the formulation variable. The strong relationships between early interest group and public involvement activity and the formulation variable provide clear support for the *a priori* hypotheses. The data for the relationship concerning environmental interest groups suggest that, when these groups are involved at a very early stage of planning, the types of alternatives considered reflect environmental factors to a greater degree. The lack of a statistically significant correlation when using the DTS as a cutoff suggests that these groups have substantially less influence on plan formulation once planners have developed a tendency to

TABLE 8-1

CORRELATION COEFFICIENTS (τ)--FORMULATION VS.
TIMING OF AGENCY AND PUBLIC INVOLVEMENT (N = 14)

	Cutoff Date	
	DOC	DTS
Number of "substantive" environmental agency contacts before cutoff date	-	-
Number of "substantive" environmental group contacts before cutoff date	$.3721^{+}$	-
Number of public meetings and workshops before cutoff date	$.3685^{+}$	$.3985^{++}$
Number of planning workshops (agency, group, or public) before cutoff date	$.4260^{++}$	$.5157^{++}$

(-): no significant correlation found.

$^{+}$Significant at $p < .10$.

$^{++}$Significant at $p < .05$.

favor a specific proposal. The strong relationship found between the number of public meetings and workshops before the cutoff dates and the formulation dependent variable suggests that, for studies in which an effort is made to substantially involve publics at an early stage, a more environmentally sensitive formulation process results. That the correlations are statistically significant using both cutoff dates suggests that Corps planners may be receptive to inputs which they perceive as having a broader basis of support even if they come relatively late in the process (i.e., after the DOC but before the DTS). Even more striking, however, are the correlations between the formulation variable and the number of planning workshops held before the cutoff date. The findings of Section 1 of Chapter 7 suggested that the increased "give and take" allowed by the workshop format enhanced the environmental sensitivity of the planning process. The correlations in Table 8-1 argue that where such an interactive approach (i.e., workshops) is undertaken at the early stages of planning even greater consideration may be given environmental factors in subsequent decision-making.

Because there were a number of studies in the sample of recent studies that had scores of zero for the timing variables shown in Table 8-1, some further statistical analysis of the data was undertaken using the median test. In using this test each timing variable score was defined as being either zero or non-zero. Median tests were then used to evaluate whether studies having non-zero scores on the timing variables had significantly higher formulation scores than those which had zero scores on the timing variables. Results of applying the median test showed formulation scores to be significantly higher where at least some public involvement activity (i.e., public meetings or workshops) was undertaken before the DOC and the DTS (both at $p < .05$). Studies where some substantive interest group contact was accomplished before the DOC had generally higher formulation scores than those which did not, although the difference was significant only at $p = .15$. Studies where at least one planning workshop was held before the DOC or DTS showed significantly higher formulation scores as well (at $p < .05$). Thus the relationships indicated by the correlation coefficients in Table 8-1 are supported by median test results. Viewed collectively, the results highlight the importance of early coordination and involvement of affected publics to the increased influence of environmental factors in plan formulation. It would be fallacious, however, to assert that these relationships imply a direct causal link between the formulation variable and the timing variables. Insights gained throughout the research suggest that high scores on both the timing and formulation variables are more the result of a conscious attempt on the part of District planners and their superiors to meet the intent of NEPA by using a planning process which actively seeks out the views of affected publics and incorporates those views in the formulation of alternative plans. In this regard the leadership of the District hierarchy seems to be very important. This observation is further discussed in the next section which analyzes the timing of ER unit activity in developing information through coordination and field study; the formal development of *a posteriori* hypotheses reflecting the interpretations above are taken up in Chapter 9.

8.2 Timing of ER Unit Information Gathering

The *a priori* hypotheses regarding timing of ER unit activity are as follows:

> "The influence of environmental information on the formulation of alternative plans will be increased if there is increased activity of the environmental unit in generating that information before the study manager develops a preference for a single alternative and before the agency tentatively selects a proposed plan."

The activity of the ER unit in generating environmental information is assumed to be reflected in coordination between the ER unit and other agencies and interest groups, participation of ER personnel in public involvement efforts, conduct of field studies, and preparation of written documentation of environmental effects by ER personnel or their contractors. This section will discuss the timing of these activities and its implications for the increased influence of environmental considerations in planning and decision making in Survey Investigations.

As discussed earlier, at the beginning of Section 8.1, the shortcomings of late review of environmental documents have often been cited as an obstacle to the effective implementation of NEPA. A good deal of activity, in the form of interagency coordination and field work, goes into the preparation of an EIS; it seems plausible that if this activity occurs early in the planning study, some of the shortcomings of late stage review may be overcome. The CEQ emphasizes the early development of environmental information in its 1974 annual report:

> ...environmental analysis needs to be prepared as a rough approximation during the initial planning of a project and then gradually refined as the planning of a project proceeds and as alternatives are identified, analyzed, and perhaps discarded. In this way the environmental analysis at each stage in the planning process is appropriate to the decisions to be made at that stage ... and the crucial goal of NEPA--consideration of the environment in the planning of a project --is accomplished (CEQ, 1974, pp. 411-412).

Clearly, CEQ envisions the generation of environmental information prior to any decisions regarding plan selection. Randolph and Ortolano (1975, p. 5-1) further assert that only if this information is generated before the earliest planning decisions will the alternatives produced by the planning process be "...conceived in the light of environmental as well as technical and economic considerations". Proposed CEQ regulations further stress the need for early development of environmental information (CEQ, 1978). Thus there is a clear case for early information gathering activity in the effort to meet the intent of NEPA. The following discussion seeks to investigate the hypothesized relationship between this activity and the influence of the information obtained on the formulation of alternative plans.

Components of Analysis*

As a part of the field interview questionnaire, environmental specialists were asked to name the agencies and interest groups with which they had had "frequent and meaningful" exchanges of information during the course of the study and the approximate date and nature of the first "substantive" exchanges of information with each. In addition, the dates of any public involvement activities, such as meetings and workshops, in which members of the ER unit had actively participated, were obtained.

---

*For a description of the actual interview questions used and an example of score computation refer to Appendix A, Section 5.

Environmental specialists were also asked to describe any field work and literature reviews done by them (or for them by contract) during the course of the study, as well as the approximate dates at which each was completed. Since most of this type of activity results in preparation of environmental documents, the nature and dates of completion of all such documentation prepared by the ER unit was also obtained. Another series of questions asked about the nature and timing of EQ plan preparation.

The scoring procedure used to evaluate the timing of these activities is similar to that described for the timing of external coordination discussed in Section 8.1. Variables characterizing activities undertaken before consensus had developed for a specific proposal were constructed by comparing the dates of "substantive" information transfer, field work completion, document preparation, etc., to the DOC obtained from the study manager interview. Similarly, variables characterizing activity before a tentative selection had been made were constructed by comparison of the relevant dates with the DTS obtained from the study managers. The timing of coordination variables thus constructed reflect the number of agencies and groups having "substantive" information inputs prior to the cutoff date (DOC or DTS), and the number of meetings and workshops attended by ER unit personnel prior to the cutoff date; inputs provided and meetings attended after cutoff dates were not counted. The field work timing variables were constructed by counting the number of field studies and literature reviews completed prior to the cutoff dates.* Similarly, documentation timing variables are a simple count of those reports, assessments and brochures completed before cutoff dates. The variable characterizing the timing of EQ plan preparation takes on a value of 1 if EQ planning was begun before the cutoff date and a value of 2 if EQ planning was completed before the cutoff date. Thus all the activity timing variables take on integer values, a 0 if nothing occurred before the DOC or DTS and higher numbers for greater amounts of activity prior to those dates. As was discussed in Section 8.1, while this scoring system may bias against studies having lower overall levels of activity, an alternative scoring system which avoids this bias resulted in the same rank ordering of studies by independent variables. As a result, this alternative scoring method was dropped from further analysis. Since higher numbers on these independent variables are associated with increased activity of the ER unit prior to the cutoff dates, positive association between them and the formulation dependent variable should be viewed as support for the *a priori* hypotheses.

---

*This procedure is admittedly somewhat crude, since in many cases information is obtainable before the field study is actually completed.

Results of Analysis

Table 8-2 shows the rank-order correlations between the formulation variable and various independent variables characterizing the extent of activity of the ER unit before the two cutoff dates used (the DOC and the DTS). The large number of strong positive correlations provide clear support for the *a priori* hypotheses that earlier activity by ER personnel in developing environmental information is associated with the increased influence of that information on plan formulation. Observe, also, that the variables characterizing the timing ER unit coordination activity (the first four listed in Table 8-2) show much stronger correlations with the formulation variable when the DOC is used as the cutoff date than when the DTS is used. A possible explanation for this is that information obtained from outside sources by the ER unit is much less useful after planners have developed a favorable attitude toward a specific proposal, even if that proposal does not yet have any "official" sanction. While it may be impossible to prevent the development of such attitudes or preferences for a specific proposal (which may be strongly favored by local sponsors), the data suggest that early coordination efforts by the ER unit may enhance the consideration given environmental factors in Survey Investigations.

The variables characterizing field work and documentation (i.e., the last three variables in Table 8-2) show correlations with the formulation variable that are higher when the DTS (as opposed to the DOC) is used as the cutoff date. This is just the reverse of the situation noted above for the coordination variables. A possible explanation for this reversal (i.e., for the fact that the correlations for the field work and documentation variables are higher using the DTS) is that considerable information

TABLE 8-2

CORRELATION COEFFICIENTS (τ)--FORMULATION VS. TIMING OF ER UNIT INFORMATION GENERATION (N = 14)

	Cutoff Date	
	DOC	DTS
Number of "substantive" environmental agency contacts before cutoff date	$.5421^{++}$	-
Number of "substantive" environmental group contacts before cutoff date	-	-
Number of public meetings or workshops before cutoff date	$.5904^{++}$	$.5592^{++}$
Number of all "substantive" contacts and meetings before cutoff date	$.5233^{++}$	$.2695^{+}$
Number of field studies and literature reviews completed before cutoff date	$.3871^{++}$	$.6094^{++}$
Number of environmental documents completed before cutoff date	$.4280^{++}$	$.5595^{++}$
Extent of EQ planning completed before cutoff date	$.3037^{+}$	-

(-): no significant correlation found.

$^{+}$Significant at $p < .10$.

$^{++}$Significant at $p < .05$.

can be obtained from field work and documentation activity before that work is actually completed; moreover, both field work and documentation are carried out over longer periods of time, making it less likely that these activities are completed before attitudes favoring a specific proposal are formed. Nevertheless, there is clear support for completion of field work and environmental documentation before agreement is reached between planners, local sponsors, and higher level reviewers over selection of a particular alternative. Furthermore, the correlation between the formulation variable and the variable characterizing timing of documentation adds support to the earlier findings of Chapter 7, Section 1, that circulation of a pre-draft EIS may help to overcome the problems associated with the late stage coordination occurring under present Section 102 procedures.

The correlations for the variable characterizing timing of EQ planning suggest that EQ planning efforts undertaken before favorable attitudes toward a specific proposal are formed may lead to the increased influence of environmental information on plan formulation. If undertaken later, the EQ planning efforts are in danger of being a mere "tack-on," satisfying some of the procedural requirements of the Principles and Standards (P&S), while failing to meet its intent, namely, that enhancement of Environmental Quality be a goal of agency planning. In 6 of the 11 recent studies where EQ plans were prepared the process of preparing the plan could be characterized as follows: a late stage review of the alternatives that had been considered earlier in the planning process was conducted and the one with the "least environmental impact" was identified and labeled as the EQ plan.* In one case, a study manager felt that the District Engineer virtually required that the recommended plan (which was also the NED plan**) be labeled the EQ plan as well, so as to avoid any possible delays or questions in review. In fairness, it should be noted that the Corps P&S regulations (the ER 1105-200 series) only became operational in November of 1975,*** and a considerable degree of uncertainty still exists among planners as to how the intent of the P&S can best be met. Impressions obtained in the field interviews suggest that unless careful attention is paid to the EQ planning process, it may come to be viewed only as another procedural obstacle to the implementation of plans formulated largely on the basis of economic and technical considerations.

As in the case of the independent variables discussed in Section 8.1 above, a number of studies in the sample had scores of zero for the timing variables presented in Table 8-2. Further analyses, based on the use of the median test, were performed to verify that the findings indicated by the correlations in Table 8-2 are valid despite the presence of tied ranks caused by these zero scores. These tests compared the formulation scores of studies where no ER unit activity was undertaken before the cutoff dates with those where any amount of such activity was undertaken before the cutoff dates. The results of these tests were uniformly consistent with the findings indicated by the correlation coefficients presented in Table 8-2. In all but one case, the formulation scores were significantly higher (with $p < .05$), where at least some coordination, field work, and documentation activity was undertaken before the cutoff dates. The one exception concerned the variable characterizing EQ planning activity; in this instance, the median test showed that the formulation scores were higher for projects in which some EQ planning activity was carried out before the DOC, but this result was significant only at $p = .15$.

---

*Such a process of selecting the "least damaging alternative" as an EQ plan is, in fact, contrary to Corps regulations.

**The National Economic Development (NED) plan, which is a Corps requirement in response to the P&S, is the alternative which provides the greatest net "tangible economic benefit."

***However, working drafts of these regulations were available to planners in 1974.

The analysis above presents a strong case for the early involvement of ER personnel in the process of coordinating with other agencies and publics and conducting and documenting field work and literature reviews. But, as mentioned in Section 8.1, these correlations should not be viewed as implying simple, direct causality. One of the most striking observations of the data showed that the studies scoring the majority of the non-zero values on the activity timing variables, and to a lesser degree on the public involvement timing variables, were concentrated in four of the eight District offices included in the research. These four Districts were also those in which the interviewer perceived the greatest enthusiasm and leadership on the part of the District hierarchy for including environmental factors in all aspects of planning. This suggests that both the high scores on the formulation variable and the larger amounts of early coordination and information generating activity are the result of a positive commitment on the part of branch and division chiefs within the District office, and on the part of the District Engineers, to a planning process which actively seeks out environmental information pertinent to the problem at hand and incorporates that information into decision making. This notion is supported by comments made by several study managers to the effect that the field interviews paid too little attention to the role of the District hierarchy in decision making. The findings of Chapter 7 also suggested that the leadership of the hierarchy may be very important in determining the consideration given environmental factors.

In Section 3 of Chapter 7 it was noted that the studies having the highest formulation variable scores were those in which study managers perceived the least pressure from members of the hierarchy concerning environmental issues. In Section 4 of the same chapter it was noted that the studies having the highest formulation variable scores were those where study managers felt least constrained by the preferences of members of the hierarchy in dealing with information from other agencies and publics. These earlier observations, together with the interpretations presented above regarding the timing variables, suggest that leadership from the Corps hierarchy may be a necessary condition for the increased influence of environmental factors in Survey Investigation planning. The apparently central role of the hierarchy in explaining the influence of environmental considerations in pre-authorization planning is explicitly addressed in the next chapter on multi-variate analysis.

Chapter Nine

A POSTERIORI HYPOTHESES CONCERNING THE INFLUENCE OF ENVIRONMENTAL INFORMATION

The discussion below concerns the results of multi-variate analysis of the inter-relationships between the variables associated with the principal findings presented in Chapters Five through Eight. This exploratory analysis has two goals: first, to describe the combined effects of the bivariate relationships previously discussed with regard to the influence of environmental information on planning outcomes and second, to speculate on a more general "model" of environmental decision-making which could provide a basis for future research. To a large degree this multivariate analysis represents an attempt to understand and describe the complexity of the Corps' planning process and the diverse interactions between variables that could not be accounted for in the context of the bivariate relationships discussed in the preceding four chapters. The analysis yields a number of _a posteriori_ hypotheses regarding environmental decision-making by the Corps.

The main analytic tool used in this chapter is partial rank order correlation. This technique permits the evaluation of effects of "third variables" on two variable relationships by the statistical "control" of the third variable.* Controlling a third variable, the "uncontaminated" relationship between two other variables can be examined. If the correlation between two variables, i.e., an "independent" variable and a "dependent" variable, is _reduced_ by the control of a third variable, then the third variable is interpreted as an _intervening variable_; that is, some proportion of the variance in the dependent variable originally thought to have been explained by the independent variable is, instead, the result of the influence of the third, "control", variable. If the correlation between two variables, i.e., an "independent" variable and a "dependent" variable, is _increased_ by control of a third variable, the third variable is interpreted as a _suppressor variable_; that is, the apparent lack of a relationship between the independent and dependent variables is, at least partly, the result of the influence of the third variable. The extent to which the identification of intervening and suppressing variables can be used to explain complex relationships depends a great deal on the researchers' idea of the causal relationships between the variables. In the discussion below, various causal relationships, postulated a posteriori on the basis of intuitions and observed inter-relationships between the independent variables examined in the preceding chapters, are elaborated* using partial correlation analysis to determine if the intervening and suppressing variables thus identified are consistent with these postulated causal relationships.

---

*For an introduction to the concept of partial correlation, refer to Section 7.5. A rigorous discussion of the derivation of partial correlation coefficients may be found in Appendix B.

The chapter is divided into two sections corresponding to preauthorization and post-authorization planning, respectively. A general paradigm guiding the analysis discussed in both sections is that the Corps planning process is essentially an "open system" of decision-making.** The outputs of the system are represented by solutions (i.e., plans or projects) to water resource problems and needs. A characteristic of open systems is that they are functionally dependent on the environment or context in which they operate. The Corps planning process depends, for resources and approval, on several "actors" outside its own organization (most notably Congress and local sponsors). The outcomes of the planning process (which are characterized herein by the dependent variables) may thus be viewed as the product of these external dependencies and the organizational response to them.

Another concept which proves useful in interpreting the results of the multi-variate analysis is that of the social function or social effectiveness of organizations.* The social effectiveness of the Corps has long been held to rest on its ability to implement the budgetary wishes of Congress in response to local needs (see, e.g., Maass, 1950, and Jenkins, 1976). By and large, the federal budgetary system in the past has evaluated Corps water resources project proposals on the basis of an economic benefit-cost analysis. Although the environmental mandates of the past 10 years have given increasing influence to non-economic values in civil works planning, the fundamental importance of producing economically justifiable and implementable projects to the social effectiveness of the Corps remains.** Furthermore, without agreement between local sponsors and the Corps no recommendation of Federal action can be made. Thus the importance of consensus between local sponsors and the Corps is seen as essential for the social effectiveness of the Corps. Assuming that the socially effective service rendered by the Corps consists, in part, of providing economic benefits through reduction of flooding, navigation improvements, or hydropower production, the process of devising economically justifiable and locally acceptable plans can be seen as essentially equivalent to the social function of distributing Federal economic benefits according to the wishes of Congress.

---

*While the Kendall correlation coefficient has been generalized to a partial, regrettably no test of significance has been developed (Siegel, 1956, p. 228). Thus, while the technique is useful in providing further insights into the data, the coefficients produced cannot be used to test whether the resulting interpretations are statistically significant. Thus the plausibility of the interpretations must rest largely on intuition developed in connections with the research as a whole and on the many other discussions of organizational and bureaucratic behavior available in the literature.

**For a discussion of organizations as "open systems", see, e.g., Katz and Kahn (1966).

9.1 Pre-Authorization Planning Studies

Before presenting the multi-variate analysis of the pre-authorization studies included in the research, a brief review of the characteristics of Corps Survey Investigations is provided. Survey Investigations, or feasibility studies, are initiated at the request of individual Congressmen, subject, of course, to approval by their colleagues. The pre-authorization study represents the first step in developing the base of information necessary to implement a Federal project. Thus at the outset of most pre-authorization studies, relatively little information is available concerning the environmental and social setting of potential projects or the relevant technical and economic data necessary for their design.* Because of the higher degree of uncertainty at this stage of planning and because of variations in policy implementation from District to District, the preauthorization planning process varies in many respects from one study to the next. The Survey Investigation generates information concerning the economic, technical, social and environmental aspects of local water resource problems and provides a recommendation for appropriate action. Such action may be to "do nothing" or to conduct more detailed study of a proposal which appears feasible and implementable. Decisions concerning the problems to be addressed, the alternatives to be considered, and the action to be recommended take place within a framework which is provided by the information generating process used in the Survey Investigation. This process typically consists of structured attempts to involve publics and other interests through activities such as planning workshops or agency coordination and unstructured information gathering, such as informal communications (e.g., telephone conversations) between planners, their superiors, local sponsors and other interests.

---

*For a discussion of social effectiveness see, e.g., Downs (1967).

**Most planners taking part in the field interviews seemed to feel that, despite procedural guidance allowing the recommendation of projects exhibiting negative "net economic benefits" where there are overriding environmental concerns, such projects would never, in fact, be approved.

The key groups of "actors" in Survey Investigations are local sponsors and other local interests, planners (study managers, environmental specialists, and their colleagues), and the Corps hierarchy, which supervises and reviews decision making. These actors are all closely involved in an information generating process through which problems and impacts are defined and within which decisions regarding alternatives and recommendations are made. The analysis of the preceding chapters has shown that these three groups of actors and several aspects of the information generating process itself (e.g., public involvement activity) may significantly affect the consideration given environmental factors in Survey Investigations.

Summary of Multi-Variate Analysis Results

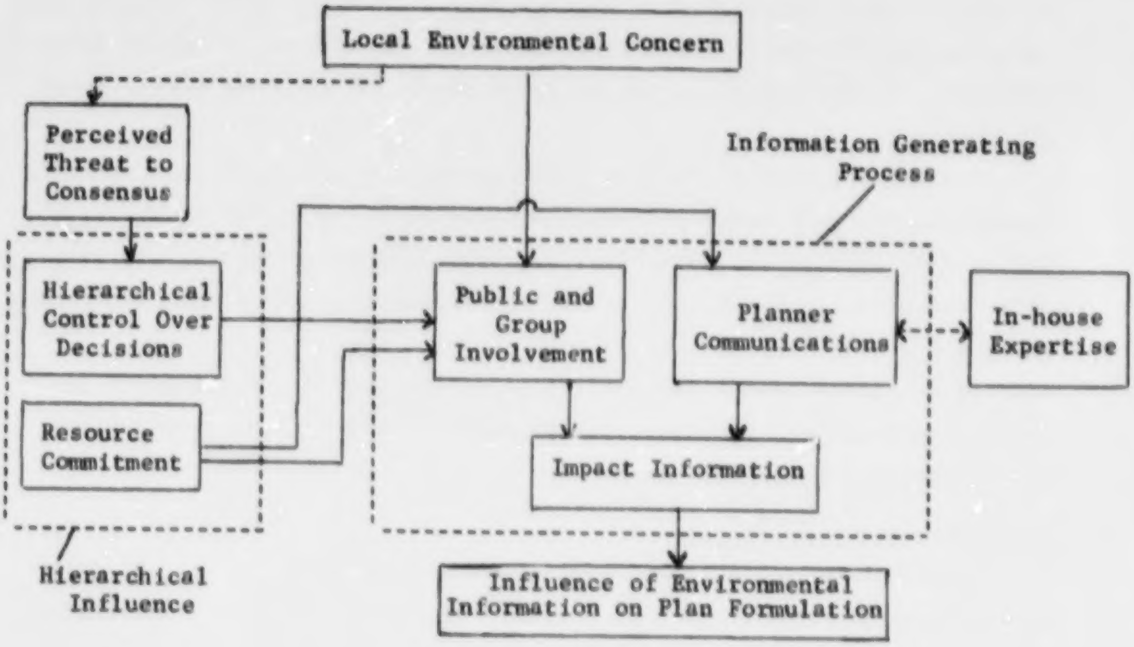
Figure 9-1 summarizes the arguments that are elaborated in the subsections that follow. The relationships indicated are, in fact, a complex of a posteriori hypotheses which appear to partially explain the observed interrelationships examined by the multi-variate analysis and which could

---

*Some Survey Investigations are re-studies of prior investigations which, for lack of economic feasibility or other considerations, resulted in negative reports. Three of the fourteen studies in the sample could be classified as re-studies.

Figure 9-1

Pre-authorization Planning
Decision Making Structure


Local Environmental Concern
Perceived Threat to Consensus
Information Generating Process
Hierarchical Control Over Decisions
Public and Group Involvement
Planner Communications
In-house Expertise
Resource Commitment
Impact Information
Hierarchical Influence
Influence of Environmental Information on Plan Formulation

be subjected to further research. The translation of local environmental concerns into environmentally sensitive planning outcomes occurs through an information generating process. This process is characterized by the development of environmental information through involvement of local interests in the planning process and through communications between planners and environmental specialists within the Corps. The decisions made within this framework of information result in the formulation of alternative actions reflecting, to some degree, the concerns of the local public regarding environmental issues. The information gathering process is strongly influenced, however, by the Corps hierarchy. District level policy and resource commitments may encourage a more "open" information gathering process by fostering greater public involvement efforts and more informal communication between planners. However, if members of the hierarchy, particularly District Engineers, perceive local environmental controversy as a possible threat to the establishment of the consensus necessary for the social effectiveness of the Corps, increased hierarchical control may discourage the involvement of publics in the generation of information thereby suppressing the degree to which local environmental concerns are reflected in planning outcomes. The discussion which follows elaborates on the multi-variate analyses which led to these _a posteriori_ hypotheses.

Table 9-1 presents, both as a review and for reference in subsequent dicussion, the rank order correlations between the formulation variable and various independent variables, introduced in the preceding chapters, which characterize the three sets of actors and the information generating process mentioned above. The discussion below considers, in turn, each of the these actors and their interaction with the information generating process, and elaborates on the ways in which those interactions may influence planning outcomes.

Local Environmental Values

The Corps pre-authorization planning process is dependent on local interests in two important ways: first, initiation of Survey Investigations by Congressional request and authority is primarily the result of concern expressed by local interests over perceived water resource problems and second, for any Survey Investigation recommending Federal action, cost sharing agreements must be reached between local sponsors (typically local governments or special districts) and the Federal government. The cost sharing requirement ensures that any potential Federal action is acceptable to local sponsors. Thus, the recommendations reached in the Survey Report can be viewed as represesenting a consensus between local interests and the Corps regarding the best solution to the water resource problem.

Inasmuch as the decision making which leads to the establishment of consensus takes place within the framework provided by the information generating process, it could logically be expected that any consensus achieved would primarily reflect the information obtained through that process and, accordingly, the views of the providers of that information. This, in turn, suggests the following _a posteriori_ hypothesis: if local

TABLE 9-1

VARIABLES USED IN THE MULTI-VARIATE ANALYSIS OF PRE-AUTHORIZATION PLANNING

	Reference Section*	τ**	p-value
LOCAL ENVIRONMENTAL VALUES			
1 Local Environmental Issue Index	7.2	.2433	n.s.
PLANNER INFLUENCES			
2 Communication Interactivity	5.2	.3814	.040
3 Communication Informality	5.2	.4495	.041
HIERARCHICAL INFLUENCES			
4 Influence of District Engineer (index)	7.5	-.4601	.020
5 Degree of Hierarchy Constraints (index)	7.4	-.2137	n.s.
6 Relative Size of ER Unit (ratio)	5.1	.5364	.004
INFORMATION GATHERING PROCESS			
7 Extent of Public Involvement	7.1	.5200	.006
8 Extent of Interest Group Involvement	7.1	.3139	.078
9 Interactive Involvement Index[†]	9.1	.4423	.042
10 Environmental Study Index[††]	9.1	.2110	n.s.
11 Impact Information Index	7.5	.3412	.055

---

*Entries in this column are the sections in this report in which the independent variables are first mentioned.

**Entries in this column are the Kendall rank order correlation coefficients between the independent variables and the formulation variable.

[†] This index reflects the extent of public involvement efforts beyond those required by regulations. See Appendix A, Section 4, for details.

[††] This index reflects the level of activity of environmental specialists in the planning study. It is the sum of the number of field studies and literature reviews conducted plus the number of environmental documents prepared.

interests are concerned about environmental issues, this concern will manifest itself in the process of generating environmental information, and this information will influence the formulation of alternatives. The reasoning leading to this a posteriori hypothesis is also supported by observed positive correlations between measures of local concern over environmental issues (summarized in variable 1 of Table 9-1) and variables reflecting public and interest group involvement activity (variables 7 and 8 in Table 9-1).*

If the hypothesis stated above were valid, one would expect that variables characterizing the information gathering process, especially those reflecting the involvement of publics and interest groups (i.e., variables 7, 8, and 9 in Table 9-1) would act as intervening variables in the observed positive relationship between the formulation variable and the variable reflecting local environmental concern (variable 1 in Table 9-1). If they were behaving as intervening variables, then the correlations between the formulation variable and the index reflecting local environmental concern would decrease when the public and interest group involvement variables were "controlled" using partial correlation, validating the portion of Figure 9-1 which shows local environmental values influencing plan formulation through public and interest group involvement.

Table 9-2 shows the results of partial correlation analysis of the variables herein discussed concerning pre-authorization planning. Both the original bivariate correlation coefficients and the resulting partial correlation coefficients are presented. The table is broken down into segments that correspond to the main arguments discussed herein.

The first segment of Table 9-2, which reflects the partial correlation analysis of interrelationships between local values and the information gathering process, shows that the variable characterizing interactive involvement (the "controlled" variable) acts as a strong intervening variable between the formulation variable and the variable reflect local environmental concern. In fact, some intervening effects were noted for all the measures of public and interest group involvement (i.e., variables 7 and 8, as well as 9). However, interactive involvement, which reflects extensive

---

*For example, the public involvement index was found to be significantly related to the perceived degree of local environmental interest ($p < .10$), and the perceived degree of local environmental criticism was significantly related to the interest group involvement index ($p < .05$).

TABLE 9-2

RESULTS OF MULTI-VARIATE ANALYSIS OF PRE-AUTHORIZATION PLANNING

Variables Used as Controls	Independent Variable Relationship Tested	τ	τ_p
I. Interactive Involvement (9)	Local Issue Index (1)	.2433	.0563
II. Impact Information (11)*	Public Involvement (7)	.5200	.3169
	Interest Group Involvement (8)	.3139	.1765
	Interactive Involvement (9)	.4423	.2460
III. Communication Informality (3)	Impact Information Index (11)	.3412	.0151
IV. Degree of Hierarchy Constraint (5)	Local Issue Index (1)	.2443	.3443
Relative Size of ER Unit (6)	Extent of Public Involvement (7)	.5200	.3589
	Environmental Study Index (10)	.2110	.0323

*Numbers in parentheses refer to variable numbers given in Table 9-1.

use of workshops and more frequent dialogue with publics and interest groups, showed the strongest intervening effects . These results suggest that local environmental values are better reflected in planning outcomes when greater attempts are made to establish direct and open dialogue between environmental interests and Corps decision makers.

The view that local environmental values are reflected in planning outcomes through interactive involvement of interest groups and individuals is also supported by other data. Strong positive correlations were noted between measures reflecting the acquisition of new information concerning adverse impacts from interest groups and citizens (summarized in variable 11 of Table 9-1) and variables reflecting the extent of involvement activity with them (e.g., variables 7, 8, and 9 in Table 9-1). In turn, greater amounts of this new information concerning impacts, was significantly related to the formulation variable. If the expression of local environmental values through involvement in the planning process results in the generation of information concerning adverse effects, then one would expect the acquisition of that information to be an intermediate step between its source (e.g., through public and interest group involvement) and use (as reflected in the formulation variable). In other words, the index of impact information (variable 11 in Table 9-1) would be expected to intervene in the positive relationships between the formulation variable and the variables reflecting involvement of interest groups and the public (variables 7, 8, and 9 in Table 9-1).

As can be seen in the second segment of Table 9-2, the index of impact information (the "controlled" variable) acts as a strong intervening influence in the relationships between the public, interest group, and interactive involvement variables and the formulation variable. These results strongly support the notion that the identification of adverse project effects is an important outcome of the information gathering process, and in fact, explains part of the strong association noted between the formulation variable and the variables characterizing public and interest group involvement. Furthermore, they give added credence to the a posteriori hypothesis that attempts to involve local environmental interests in generating environmental information, in making environmental information part of the framework within which decisions are made, results in more effective translation of environmental values into sensitive planning outcomes.

The analysis thus far suggests the following causal order of influences (see Figure 9-1 above): local environmental values, expressed by concerned citizens and interest groups, define part of the information framework within which decisions are made through the involvement of those interests in public meetings and workshops, and through other dialogues with planners. This information, which appears mainly to concern adverse impacts, thus provides what Pfeffer and Salancik (1978) call the "enacted environment" of decision making. This is the framework within which consensus is reached between the Corps and local sponsors. To the extent that the information generating process encourages the development of environmental information (e.g., through more extensive coordination with interest groups), that environmental information becomes a part of the framework within which problems and potential solutions are defined.

However, local interests are not the only actors influential in Survey Investigations nor is public and interest group involvement the only source of environmental information available to planners. The discussion below considers the role of study managers and environmental specialists in defining the framework of decision making.

Planner Influences

The study manager is, perhaps more than any other single individual, the person most responsible for the conduct of information generating activities in a Survey Investigation. He or she often has considerable discretion in determining the types of public involvement activity undertaken, the extent of coordination with other interests and agencies, and the management of information developed by other Corps personnel. With regard to the development of environmental information, the study manager depends a great deal on the environmental specialist, whose responsibility it is to prepare the EIS.* The degree to which study managers and environmental specialists communicate in an informal and interactive way has been shown to be significantly related to the influence of environmental information on plan formulation.

Assuming that decision making in Survey Investigations takes place within a framework based upon the information generated during the planning process, it is to be expected that communications between study managers and environmental specialists which more effectively provide study managers with environmental information would be associated with outcomes which reflect that information to a greater degree. The significant correlations between the two communications indices (variables 2 and 3 in Table 9-1) and the formulation variable bear this out; however, these correlations do not reveal the mechanism by which this communication comes to be reflected in planning outcomes. Positive correlations between the indices of communication and the index reflecting acquisition of new information on adverse impacts (variable 11 of Table 9-1) suggest that communication between study managers and environmental specialists serves to increase the amount of environmental information present in the decision framework, and thereby influence decisions made in the search for consensus. If this a posteriori hypothesis were true, one would expect communication variables to intervene, in this case as antecedent influences, in the relationship between the formulation variable and the index of impact information.

---

*Less commonly, the study manager may prepare the EIS using the environmental specialist as a consultant.

The third segment of Table 9-2 shows the results of partial correlation analysis in which the effects of informal communication were controlled and the relationship between the index of impact information and the formulation variable examined. The great reduction in the correlation between these latter two variables suggests that the presence of environmental information in the decision making framework is highly dependent on the extent to which study managers and environmental specialists communicate environmental information freely between each other.

Thus far the multi-variate analysis has shown that the close involvement of concerned local citizens and free communication between study managers and environmental specialists are very important to the establishment of a framework in which environmental information can be utilized in decision making. However, nearly all decisions are either supervised or reviewed by members of the Corps hierarchy and thus the discussion below considers hierarchical influences in the multi-variate analysis of pre-authorization planning.

Hierarchical Influences

The importance of the Corps hierarchy to the decision making which occurs in Survey Investigations is manifested by the extensive review process required by regulations.* Most major decisions, from the scheduling of study activities in the Plan of Study to the recommendation of a specific action, are reviewed by members of the hierarchy in the District, Division, or in some cases, Washington offices of the Corps. Thus the outcomes of the planning process can be influenced substantially by these reviewers and supervisors.

---

*The points at which hierarchical review is required are described in Section 2.2.

The analysis of the preceding chapters showed that where study managers and environmental specialists perceived greater hierarchical involvement in and control over decision making, environmental information was much less influential on plan formulation. This observation is summarized in Table 9-1 by the negative correlations between the formulation variable and the variables reflecting increased hierarchical constraints over decision-making (variable 5) and increased control of decision making exerted by the District Engineer (variable 4). Analyses of other bivariate relationships quite strongly suggest that increased control over decisions and actions, exerted by the hierarchy, particularly the District hierarchy, is associated with a narrowing of scope of the information-gathering process generally, and a less interactive and informal working relationship between planners. Given the importance of interactive public involvement and informal communications in the incorporation of local environmental concerns into plan formulation, these bivariate findings suggest that increased hierarchical control may suppress the influence of environmentally concerned local citizens on the formulation process.

Partial correlation analysis was done to determine if hierarchy control has this effect. The hierarchy constraint variable (variable 5) was "controlled" and the relationship between the local issue index (variable 1) and the formulation variable examined. As can be seen in the fourth section of Table 9-2, this resulted in an increase in the correlation between the local issue index and the formulation variable confirming the notion advanced above that increased hierarchical control over decision making suppresses the incorporation of local environmental values in plan formulation decisions.

Some explanation for this suppressing role of the hierarchy may be found in the following line of reasoning. In examining other bivariate relationships it was noted that increased hierarchical control over decision-making appeared to be related to the degree of environmental controversy present in the study. If the presence of controversy were perceived as an obstacle to the achievement of consensus between Corps planners and local sponsors, then it would also represent an obstacle to the carrying out of the Corps social function, since without agreement between local sponsors and the Corps, no recommendation of Federal action can be made. Thus the importance of consensus between local sponsors and the Corps can be seen as essential for the social effectiveness of the Corps. Downs (1967, p. 182) postulates that threats to the establishment of consensus within bureaus will result in organizational attempts to ensure it, primarily through increased control and centralization of decision-making power. To the extent that environmental controversy can be viewed as a threat to the establishment of consensus,* then the increased hierarchy constraints associated with environmental criticism noted above could be viewed as such a bureaucratic response.

Downs goes on to argue that one of the means by which bureaus ensure consensus is by limiting the scope of the search for potential solutions. Assuming that the search for potential solutions is essentially equivalent to the search for a consensus alternative proposal this limiting of the scope of search appears to be demonstrated by the strong negative relationships noted earlier between the hierarchy constraint index and the information gathering variables, notably public involvement and environmental study. As a means of assuring consensus in a controversial situation, the hierarchy may control the search for a consensus solution by limiting the extent of outside involvement in the process of identifying a solution and by limiting the extent to which new (and potentially controversial) environmental information is generated.

However, the hierarchy can also encourage information gathering efforts. Bivariate analysis of other variables characterizing hierarchical influence on planning showed that the variable characterizing District resource commitments to environmental planning, namely the environmental unit size ratio (variable 6) was positively related to most of the information-gathering variables. This variable thus appears to have the opposite effect on information gathering of those variables characterizing hierarchical control over the planning process, encouraging more public involvement and more informal communication between planners and environmental specialists. To see if the size ratio (variable 6) had this effect of supporting wider public involvement efforts, the size ratio was controlled and the relationships between information gathering variables and the formulation variable examined. As can be seen in the last section of Table 9-2, controlling the effects of the size ratio variable led to reductions in the correlations between the formulation variable and the public involvement index (variable 7) and the environmental study index (variable 10) supporting the notion that a District commitment of resources to environmental planning enhances the degree to which public involvement programs and environmental studies can influence the formulation of alternative plans.

---

*It is possible, of course, that environmental controversy may not be a threat to consensus. This could happen if other feasible alternatives are present which do not have the particular adverse effect leading to the controversy.

The section below discusses aspects of the post-authorization planning process from an analytical standpoint similar to that presented above.

9.2 Post Authorization Planning Studies

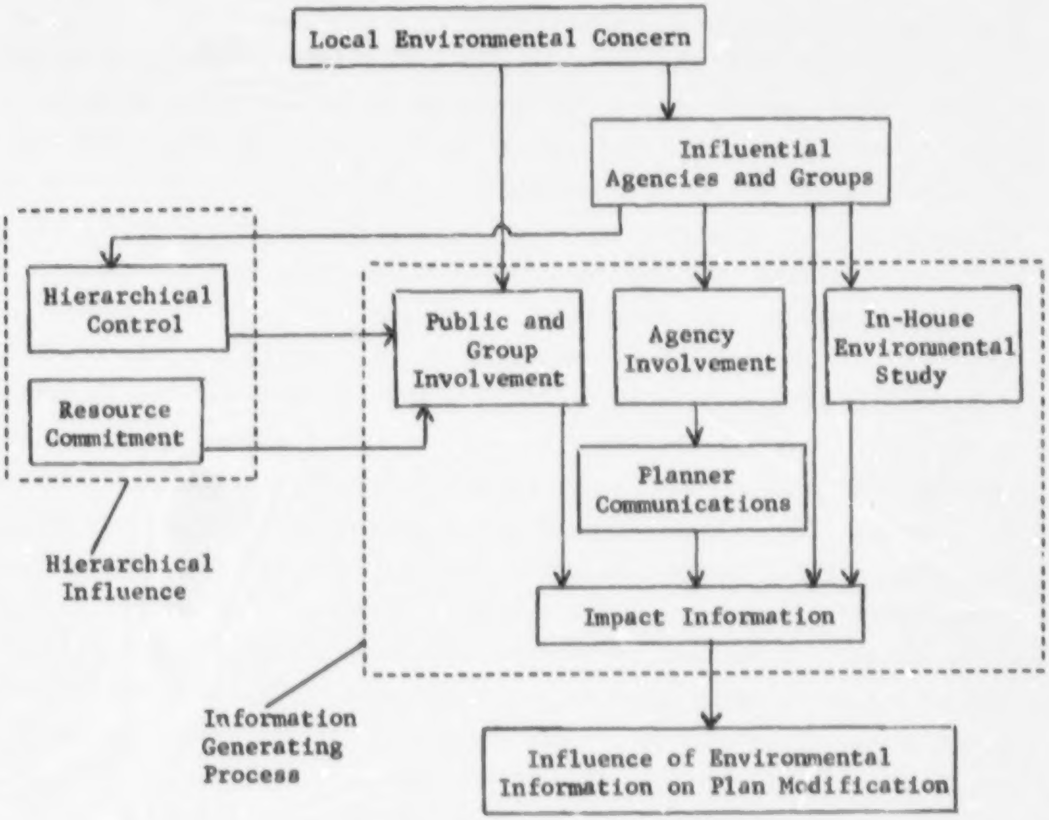
A brief review of the characteristics of the post-authorization planning process is useful for an understanding of the concepts discussed below. Post-authorization studies all have, at their outset, a Congressionally authorized plan, the feasibility of which is being re-examined in light of current circumstances in the study area. Since Survey Reports have been completed on these plans, there is generally less uncertainty concerning the potential impacts of the project and basic data gathering appears to be less important than in Survey Investigations. The Phase 1 planning process generally either affirms the findings and recommendations of the Survey Report or modifies the authorized plan to overcome problems that are either identified in the pre-authorization planning or discovered subsequently. The degree of modification made can range from very minor adjustments in designs to reformulations leading to altogether different recommendations. Although local interests, planners, and members of the hierarchy are all involved in post-authorization planning, the distribution of influence among these actors is somewhat different from Survey Investigations. In addition, another group of "actors", namely environmental and conservation agencies and national environmental groups, appear to assume an exceptionally high degree of influence in comparison to their roles in Survey Investigations.

Summary of Multi-Variate Analysis Results

Figure 9-2 summarizes the arguments elaborated below. The relationships are, in fact, a complex of a posteriori hypotheses which appear to partially explain the observed interrelationships between independent variables and which need to be subjected to further research. The translation of local environmental concerns into environmentally sensitive planning outcomes appears to occur through two different processes: through direct involvement of publics and agencies in an information

Figure 9-2

Post-authorization Planning Decision Making Structure


Local Environmental Concern
Influential Agencies and Groups
Hierarchical Control
Resource Commitment
Public and Group Involvement
Agency Involvement
In-House Environmental Study
Planner Communications
Impact Information
Hierarchical Influence
Information Generating Process
Influence of Environmental Information on Plan Modification

generating process and, more importantly, through the influence of these agencies on decision making. The information generating process yields environmental information primarily through involvement of local interests and agencies and through communications between planners and environmental specialists. Other agencies and groups seem to be able to influence the information generating process without actually participating an "involvement activities," however. This may come about due to political leverage which these agencies and national (in contrast to local) environmental groups can bring to bear at higher levels in the government. Furthermore, this influence appears to be based in a "constituency" of local environmental interests. The demands of these agencies and groups appear to encourage increased environmental study by the Corps which then becomes part of the framework of information used in decision-making. The role of the hierarchy appears to be one of encouraging participation of local interests in the information generating process, perhaps as a result of the demands of influential agencies and groups. The discussion which follows elaborates on the multi-variate analyses which led to these *a posteriori* hypotheses.

Table 9-3 presents, both as a review and for reference in subsequent discussion, the rank order correlations between the modification variable and various independent variables, introduced in the preceding chapters, which characterize these actors and the information generating process described above. The discussion below considers each of these actors and elaborates on the mechanisms by which they influence planning outcomes.

Local Environmental Values

As discussed in section 9.1, the Corps is dependent on local interests both for the initiation of planning studies and for agreements (in the form of cost sharing) that are necessary if a Federal action is to be recommended. In post-authorization planning this dependence on the attainment of consensus with local interests involved in cost sharing still holds. However, given that local sponsors have already, by this stage of planning, agreed on an acceptable recommendation (i.e., the authorized plan), attempts to involve them directly in defining the information framework of decision making in post-authorization planning appear less extensive than in Survey Investigations.

TABLE 9-3

VARIABLES USED IN THE MULTI-VARIATE ANALYSIS OF POST-AUTHORIZATION PLANNING

		Reference Section*	τ**	p-value
LOCAL ENVIRONMENTAL VALUES				
1	Local Environmental Issue Index	7.2	.4200	.025
2	Agency Influence Index[†]	9.2	.1747	n.s.
3	Interest Group Influence Index[†]	9.2	.3212	.074
PLANNER INFLUENCES				
4	Communication Interactivity (index)	5.2	-.1366	n.s.
5	Communication Informality (index)	5.2	-.4788	.036
HIERARCHICAL INFLUENCES				
6	Influence of District Engineer (index)		.2987	.078
7	Degree of Hierarchy Constraints (index)	7.4	-.1136	n.s.
8	Relative Size of ER Unit (ratio)	5.1	.3269	.063
INFORMATION GATHERING PROCESS				
9	Extent of Agency Involvement	7.1	.3126	.068
10	Extent of Public Involvement	7.1	.3034	.069
11	Extent of Interest Group Involvement	7.1	.1866	n.s.
12	Interactive Involvement Index	9.1	.3385	.065
13	Environmental Study Index	9.1	-.2611	n.s.
14	Impact Information Index	7.5	.2912	n.s.

*Entries in this column are the sections in this report in which the independent variables are first mentioned.

**Entries in this column are the rank order correlation coefficients between independent variables and the modification variable.

[†] These indices reflect the perceived influence, based on study manager and environmental specialist responses, of various "actors" over four planning tasks. See Appendix A, Section 6, for details.

The strong correlation between the index of local environmental concern (variable 1 in Table 9-3) and the modification variable indicates, however, that local environmental values are a significant influence on plan modification. The analysis of the previous section concerning Survey Investigations showed that public and interest group involvement was an important mechanism by which local values came to define the information framework for decision making. To determine if this same mechanism could explain the apparently strong influence of local environmental concern on plan modification decisions partial correlation was used to "control" the effects of the public, interest group, and agency involvement indices (variables 9, 10 and 11 in Table 9-3) and examine the resulting correlation between the modification variable and the index reflecting local environmental concern (variable 1 in Table 9-3).

Table 9-4 shows the results of partial correlation analysis of the variables herein discussed concerning post-authorization planning. Both the original bivariate correlation coefficients and the resulting partial correlation coefficients are presented. The table is broken down into segments that correspond to the discussion presented herein.

The first segment of Table 9-4, which reflects the partial correlation analysis of relationships between local values and the information gathering process, shows that the variables characterizing public, interest group, and agency involvement (the three "controlled" variables) do act, to some extent, as intervening variables in the relationship between local environmental concern and the modification variable. However, the reductions in the correlation between the local environmental issue index and the modification variable are not great, suggesting that the involvement of agencies, groups, and of local interests on a "grass roots" level (e.g., in public meetings and workshops) is not the most important mechanism by which local environmental values influence post-authorization planning outcomes.*

---

*"Grass roots", as used herein, refers to activities conducted in the study locale which rely on direct participation. In contrast, the views of some agencies or groups may be expressed through more legitimized channels, e.g., through formal agency coordination or through enlistment of the influence of individual Congressmen.

TABLE 9-4

RESULTS OF MULTI-VARIATE ANALYSIS OF POST-AUTHORIZATION PLANNING

Variables Used as Controls	Independent Variable Relationship Tested	τ	τ_p
I. Public Involvement Index (10)*	Local Environmental Issue Index (1)	.4200	.3875
Interest Group Involvement (11)	Local Environmental Issue Index (1)	.4200	.3937
Agency Involvement (9)	Local Environmental Issue Index (1)	.4200	.4090
II. Impact Information Index (14)	Public Involvement Index (10)	.3034	.2260
	Interest Group Involvement (11)	.1866	.1376
	Agency Involvement (9)	.3126	.2870
	Agency Influence Index (2)	.1747	.0142
	Interest Group Influence Index (3)	.3212	.2560
III. Local Environmental Issue Index (1)	Agency Influence Index (2)	.1747	.0142
IV. Communication Informality (5)	Local Environmental Issues Index (1)	.4200	.3328
	Agency Involvement (9)	.3126	.1775
Environmental Study Index (13)	Agency Influence Index (2)	.1747	.0942
	Interest Group Influence Index (3)	.3212	.1446
V. Influence of District Engineer (6)	Local Environmental Issue Index (1)	.4200	.3408
	Public Involvement (10)	.3034	.1979
	Interest Group Involvement (11)	.1866	-.0218
Relative Size of ER Unit (8)	Local Environmental Issue Index (1)	.4200	.2791

*Numbers in parentheses are the independent variable numbers indicated in Table 9-3.

Assuming that post-authorization decision making occurs within some framework of information analogous to that discussed for Survey Investigations, it could be expected that the impact information index (variable 14 in Table 9-3) would act as an intervening variable between the modification variable and the source of that information. In an exploratory search for such an intervening relationship, the impact information index was "controlled" and resulting correlations between several independent variables and the modification variable were examined.

As can be seen in the second segment of Table 9-4 this "control" of the impact information variable led to some reductions in the correlation between the modification variable and the extent of public and interest group involvement, confirming that involvement of publics does influence post-authorization planning outcomes to a limited extent through definition of an information framework. However, the most notable reduction of correlation took place between the modification variable and an index reflecting the influence of other agencies over decision-making (i.e., variable 2 in Table 9-3). Thus it appears that agencies do make substantial contributions to the information framework of post authorization planning. However, the relatively minor reduction in the correlation between agency involvement (as compared to influence) and the modification variable indicates that this contribution to the information framework does not depend to a great degree on direct involvement of those agencies in information generating activities.

The analysis above suggests that agency influence on the modification variable occurs partly via direct involvement in the information generating process, but more significantly via some process other than direct involvement. The following impressions, gained during the case study interviews, provides an important clue as to how the influence of other agencies is brought to bear on the modification of an authorized plan: to a large degree, the "environmental advocacy" of other agencies in post-authorization studies finds its roots in local and interest group concern over environmental issues. This observation suggests that agency influence on decision making noted above may be, in fact, another mechanism by which local environmental concern is reflected in planning outcomes. If this a posteriori hypothesis were true, one would expect the correlation between agency influence (variable 2 in Table 9-3) and the modification variable to be reduced by control of the effects of local environmental concern (variable 1 in Table 9-3).

As can be seen in the third segment of Table 9-4, controlling the local environmental issue index led to substantial reductions in the correlation between the modification variable and the extent of agency influence on Corps decision making. This finding, that agency influence is so closely associated with local concern, supports the notion, first advanced in Chapter 7, that agencies may find a "constituency" in concerned citizens and groups and that the political leverage which results from such a constituency enables the agencies to command the attention of Corps planners and to thereby influence modifications to the authorized plan.

In the sample of post-authorization studies, the apparent increase in importance of other agencies in effecting plan modifications in response to environmental considerations appears to be consistent with postulates of bureaucratic behavior advanced by Downs (1967). As one of his postulates he states:

> Organizations constantly involved in potentially threatening situations do not respond in force to every signal of potential or even actual danger received... but rather refrain from beginning significant responses until these alarm signals become very loud and are being received from multiple sources (Downs, 1967, p. 274).

While the Corps may not be "constantly" involved in potentially threatening situations because of environmental controversy over proposed projects, the increased "political capital" of conservation agencies and groups resulting from environmental mandates does serve to make their environmental criticisms, when they do occur, a significant threat to the social effectiveness of the Corps. (Recall that such a threat to social effectiveness is interpreted herein as a threat to the ability of the Corps to reach a consensus solution in a particular study and thereby distribute federal economic benefits according to the wishes of Congress.) The findings discussed above, namely, that it is the influence of other agencies, supported by concerned local citizens and organized interest groups, that chiefly determine the modification of proposed plans, suggest that if the "alarm signals" are sufficiently "loud", the Corps planning process responds by encouraging information gathering and participation of critical agencies and groups in defining accommodations which could foster consensus.

Planner Influences

As in Survey Investigations, the study manager is a key figure in coordinating information development in post-authorization studies. In the analysis of Section 9.1 it was shown that more informal communication between study managers and environmental specialists was important to the generation of environmental information used in plan formulation. Although the bivariate analyses of communication behavior presented in Chapter 5 indicate that more formal methods of communication were associated with higher scores on the modification variable, the fact that environmental specialists are relied upon for coordination with other agencies and, often, local interests, regarding environmental issues suggests that informal communication between study managers and environmental specialists may be an important factor; i.e., the information obtained by environmental specialists as a result of coordination with local interests and other agencies would be more likely to influence planning outcomes if the communication between study managers and environmental specialists is informal.

To examine the possible roles of informal communication in post-authorization planning, partial correlation was used to "control" the effects of the informal communication index (variable 5 in Table 9-3) and examine relationships between the modification variable and several other independent variables. The fourth segment of Table 9-4 shows the principal results of this analysis. Most importantly, it can be seen that informal communication between study managers and environmental specialists exhibits an intervening relationship between the modification variable and the index of local environmental concern. Thus informal communication does appear important for the translation of local environmental values into planning outcomes that reflect environmental concerns. The reduction in the correlation between the modification variable and the extent of agency involvement index (shown also in the fourth segment of Table 9-4) suggests that environmental specialists serve as an important liaison between other agencies and Corps planners.*

Further examination of the role of environmental specialists was undertaken through "control" of the effects of the environmental study index (variable 13 in Table 9-3), a measure of the activity of environmental specialists in developing and documenting environmental information in the planning study. As can be seen in the fourth section of Table 9-4, this resulted in substantial reductions in the correlations between the modification variable and the variables reflecting the influence of other agencies and interest groups. This observation suggests that documentation, by the Corps' own personnel, of environmental information of concern to these other agencies and groups, may lend credence to their demands and result in greater consideration of their views in post-authorization decision-making. These observations further emphasize the notion advanced above, that environmental specialists play an important liaison role by facilitating the process through which the views of other agencies influence decision making. Perhaps the unique position of the environmental specialist as a person knowledgeable about project features and as a liaison with non-Corps environmental interests allows him or her to identify specific project modifications which are acceptable to all parties.

Hierarchical Influences

In Survey Investigations, hierarchical influences were seen to be important determinants of the information gathering process used in decision making, acting sometimes to suppress information gathering and sometimes to encourage it. Bivariate analyses of hierarchical influence in post-authorization studies is more ambiguous; no clear role is evident. The correlations presented in Table 9-3 relating to hierarchical influences show that hierarchical constraints (variable 7) may work against the consideration of environmental factors in modification decisions but that the influence of the District Engineer (variable 6) and District resource commitments to environmental planning (variable 8) appear to foster the consideration of environmental factors in post-authorization planning. To ascertain the role the hierarchy plays in relation to the other factors influencing plan modification decisions (e.g., local concern and agency influence) an exploratory analysis was conducted "controlling" the effects of various hierarchical variables on relationships between the modification variable and various other independent variables.

---

*As documented by Price and Ortolano (1978), environmental specialists in the Bureau of Reclamation play a significant role as liaisons between "environmental spokesmen" and Bureau planners.

The fifth segment of Table 9-4 shows the results of "controlling" the effects of two hierarchical variables, the District Engineer influence index and the ER unit size ratio. As can be seen in the first group of coefficients, in contrast to the situation in pre-authorization planning, the influence of the District Engineer acts as an intervening rather than suppressing variable between the index of local environmental concern and the modification variable. Furthermore, removal of the effects of District Engineer influence resulted in decreased correlation between the modification variable and variables reflecting public and interest group involvement activity. These observations suggest that the leadership of the District Engineer may provide important encouragement for the involvement of publics and interest groups in post-authorization planning. This is in contrast to the situation in Survey Investigations, where local environmental criticism was interpreted as a perceived threat to the social function of the Corps that triggered a curtailment of public involvement activity by the hierarchy. One interpretation of these results relies on the linkage described above between the role of local environmental issues in providing a basis for the action of other agencies in attempting to influence the modification of the authorized plan. Although these other agencies have no veto power over Corps projects, they can lobby effectively against projects at the Washington level (Ingram, 1973). Perhaps, in the face of concerns voiced by these agencies, the hierarchy responds by encouraging information gathering and participation of environmentally concerned citizens and agencies in defining a consensus solution which allows projects to move on to implementation.

Other evidence that hierarchical influences may support increased consideration of environmental factors in post-authorization planning is given by the last coefficients shown in Table 9-4. After "controlling" the effects of the ER unit size ratio, taken to reflect the District level commitment of resources to environmental planning, reductions were observed in the correlation between the modification variable and the index of local environmental concern. This suggests that in those Districts where a general policy is to advocate greater participation of environmental specialists in planning, local environmental concerns are more readily accommodated in plan modifications. This may occur through increased reliance on environmental specialists as liaison between planners and other agencies and groups advocating change.

Chapter Ten

SUMMARY AND CONCLUSIONS

This chapter summarizes the findings of the research reported herein concerning the influence of environmental considerations in water resources planning and decision making by the U.S. Army Corps of Engineers. The research examined organizational characteristics, planner attitudes, the conduct of agency coordination and public involvement, and the timing of the development of environmental information. An attempt was made to rigorously test hypotheses formulated on the basis of previous research and to better define the factors which enhance the consideration given environmental factors in Corps planning.

The chapter is divided into four parts. The first two summarize the findings of the chapters above by discussing the independent variables showing the strongest relationships to the two dependent variables used in the research; the latter are variables which characterize the influence of environmental information on 1) the formulation of alternative plans during the pre-authorization stage of planning, and 2) the modification of a proposed plan during the post-authorization stage of planning. The third section of the chapter discusses the possible policy implications of these findings for the Corps and for other agencies and organizations having a direct interest in Corps planning. The final section addresses possible future research efforts, discussing directions of further inquiry.

In interpreting the discussion below, it is important to keep in mind the data base upon which the findings rest. Although much of the data collected in the case study interviews is factual in nature, much of it was collected using the impressions of the study managers and environmental specialists who were interviewed. Thus considerable faith is placed in the objectivity and candidness of these respondents. Furthermore, although the studies sampled represent approximately 10% and 20% of the pre-authorization and post-authorization studies, respectively, meeting the "milestone" criteria defining the populations of interest,* many other planning studies not included in these populations are also being carried out by the Corps. Generalization of the research findings to these other studies must recognize that policy implementation is a dynamic process of which this research only presents a "snapshot". Nevertheless, the findings discussed below provide many useful insights into the factors influencing the consideration given to environmental information in Corps planning. In the interests of clarity, the summaries present the findings of the research reported herein in more casual terms than those used in the preceding chapters. Readers wishing a more formally rigorous discussion of the points raised below should refer to the relevant chapters where those points are analyzed.

---

*The criteria used in defining these populations are described in Section 3.2.

10.1 Survey Investigations

The "formulation variable" was used to characterize the consideration given environmental factors in pre-authorization planning, (i.e., Survey Investigations). This variable reflects the extent to which specifically definable environmental planning objectives and planning constraints were addressed by the project alternatives given detailed consideration in a planning investigation.

With regard to aspects of organizational structure, the findings of the research suggest that leadership by members of the Corps heirarchy, particularly at the District level, may be very important to the increased consideration of environmental factors in Survey Investigations. A statistically significant positive correlation was found between the formulation variable and an index reflecting the breadth of duties assigned environmental specialists by written guidance and policy statements at the District office level. In Survey Investigations where environmental specialists were encouraged by District policies to participate in a broad range of planning activity (especially the task of formulating alternatives) rather than being limited to a more narrowly defined role centering on the preparation of an EIS, a greater influence of environmental information on the formulation of alternatives was noted. A significant positive correlation was also found between the formulation variable and a ratio reflecting the relative sizes, in terms of professional personnel, of the environmental unit and the planning unit within the District organizational structure. Where the environmental staff was a larger proportion of the planning staff, higher formulation scores were noted. Both these measures, the breadth of duty index and the size ratio, could be interpreted as reflecting the commitment of the District hierarchy to the increased use of environmental expertise in planning and decision-making. Where this leadership is present, the plan formulation process appears to more readily accommodate environmental information.

Another aspect of organizational processes that appears important to the increased consideration of environmental factors in Survey Investigations relates to communications. Where the communication behavior of study managers and environmental specialists was more informal and interactive, connoting a more interdisciplinary approach to decision-making, environmental information exerted a greater influence in decision making. A significant positive correlation was found between the formulation variable and an index reflecting greater reliance on informal communications mechanisms (e.g., the use of personal interaction and planning teams). Where study managers and environmental specialists relied more on formal communication mechanisms, such as standard memos or hierarchical referral, environmental factors had a much lower influence on plan formulation. A significant positive correlation was also noted between the formulation variable and an index reflecting more interactive communication, i.e., communication behavior involving frequent verbal interaction, extensive feedback, and greater expression of innovative ideas.

The results above concerning communication, as well as those concerning the duties of environmental specialists, relate to some notions put forth by Hill (1977) concerning interdisciplinary planning. Hill's arguments can be interpreted to mean that if interdisciplinary water resources planning were taking place, one would expect to find that the communications between environmental specialists and study managers would be informal, and that environmental specialists would play an active role in the formulation of alternatives. As noted above, scores on the formulation variable were generally higher for planning studies in which communication was informal and in which environmental specialists were involved in formulating alternatives. It should be noted, however, that planning teams were formally organized in only 5 of the 14 pre-authorization studies. Formulation variable scores were found to be substantially higher in these 5 studies, but the difference in formulation variable scores for studies with and without planning teams was not statistically significant at the 0.10 level.

Another area of interest examined by the research relates to the conduct of external coordination activities. One *a priori* hypothesis, for which considerable support was found, asserted that a greater commitment to or extent of external coordination would be associated with the increased consideration of environmental factors in Survey Investigations. Significant positive correlations were found between the formulation variable and measures reflecting the extent of coordination with environmental interest groups and with the public. These relationships are consistent with general impressions gained through the case study interviews, namely, that concerned citizens and interest groups are a very important source of information concerning the environmental effects of proposals in the early stages of planning. Both these observations suggest that knowledgeable, environmentally concerned local citizens can be effectively used to develop a base of information on the potential adverse effects of alternatives considered in Survey Investigations.

It is notable that *no* significant correlation was found between the formulation variable and a measure reflecting the extent of coordination with environmental and conservation *agencies*. This may reflect the reluctance of some agencies to expend resources on review of Corps proposals until it is absolutely necessary, i.e., during review of draft EIS's and Survey Reports. By the time these documents are completed, the choice of an alternative as the recommended plan has typically already been made, thus precluding significant effects on plan formulation by agency comments.

Two particular methods of involving interest groups and the public in Survey Investigation planning which appear to enhance the consideration of environmental factors are the planning workshop and the circulation of environmental information widely among the public *before* the preparation of a draft-EIS. A significant positive correlation was found between the formulation variable and the number of informal workshops, as opposed to formal meetings or hearings, used in Survey Investigations. The less authoritarian ambience of the workshop format appears to encourage dialogue (between planners and concerned citizens) that is conducive to the identification of important environmental issues. A significant positive correlation was also found between the formulation variable and measures of the extent to which information on alternatives and their potential environmental effects was circulated outside the Corps before preparation of a draft EIS. This suggests that attempts to inform and involve publics at an early stage of pre-authorization planning can help to effectively generate an information base on potential adverse environmental effects of proposals.

Further support for the notion that interest groups and the public are an important source of environmental information was found in data collected to test another *a priori* hypothesis, namely, that formulation variable scores would be higher where more new information resulted from external coordination activities. Significant positive correlations were found between the formulation variable and variables describing the extent to which study managers gained new knowledge concerning adverse project impacts through coordination with interest groups and the public. Furthermore, the more specific this information was perceived to be, the higher were the scores on the formulation variable. These observations, coupled with those above concerning workshops and environmental information circulated prior to the draft EIS, indicate quite strongly the importance of local environmental interests to the effective generation of useful environmental information in pre-authorization planning.

Another aspect of external coordination investigated in the research relates to the extent to which study managers felt constrained by various institutional, political, and other factors from responding to comments and suggestions made by interests outside the Corps. An *a priori* hypothesis asserted that if planners felt more constrained by these factors in their response, a *decreased* influence of environmental factors would be evident in plan formulation; i.e., a negative relationship would be expected between the formulation variable and a measure of the severity of such constraints. This hypothesis was only supported for one of the several different types of constraining influences that were examined. In particular, a significant negative correlation was noted between the formulation variable and an index reflecting a greater severity of constraints attributed to the imposition of the preferences of members of the Corps hierarchy. This observation suggests that the consideration of environmental factors in pre-authorization planning may be, to some extent, contingent on the degree to which such consideration is deemed desirable by planners' superiors. Other data support this view. A significant negative correlation was noted between the formulation variable and the perceived degree of control exerted by District Engineers over the four fundamental planning tasks of problem definition, alternative formulation, impact assessment and plan selection. Furthermore, several study managers interviewed pointed out that members of the District hierarchy were often very influential in determining the consideration given environmental factors in Survey Investigations. A strong negative correlation was also noted between the formulation variable and the extent to which study managers felt under greater than normal pressure from their superiors regarding environmental issues.* These findings indicate quite strongly the importance of the leadership of the Corps hierarchy, particularly at the District level, to the increased consideration of environmental information in pre-authorization planning.

The research data thus suggest that the leadership of the District hierarchy can both enhance and suppress the consideration of environmental factors in Survey Investigations. Support for environmental considerations is given when District policies encourage the participation of environmental specialists in the planning process (e.g., by encouraging environmental specialists to participate actively in the formulation of alternatives). Increased hierarchical control over decision-making, however, is associated with a decrease in the consideration given to environmental factors. Thus it appears that future research into the consideration of environmental factors in Corps planning, particularly pre-authorization planning, should carefully examine the role of the District office hierarchy in decision-making.

---

*Another a priori hypothesis asserted that increased pressure on planners regarding environmental issues would be associated with higher scores on the formulation variable. No apparent support was found for this hypothesis, and, as discussed here, some evidence exists that the contrary may be true.

A third general area of interest examined in this research concerns the timing of the development of environmental information. Two information generating processes were examined in this regard: (1) interagency coordination and public involvement activities, and (2) the activities of environmental specialists within the Corps. One *a priori* hypothesis asserted that environmental information would be given greater consideration in Survey Investigations where greater amounts of interagency coordination and public involvement were carried out before planners and local sponsors developed preferences for particular alternatives and before the tentative selection of an alternative was made. Significant positive correlations were found between the formulation variable and measures reflecting greater degrees of interest group and public involvement activity undertaken before the achievement of informal consensus between planners and local sponsors over the desirability of a particular alternative. The results suggest that the time at which information is received from the "general public" is somewhat less of a critical issue than the time at which information is received from environmental interest groups. In the case of such groups, the later the information is received, the less influential it appears to be. One explanation may be that information generated through activities designed to involve the general public is viewed as "more representative" of the wishes of local citizens, and therefore it may be influential even after preferences for particular actions are formed. Other data support the notion that the perception of "representativeness" is important to the consideration of environmental concerns. The formulation variable was found to take on significantly higher values where study managers viewed particular environmental constraints as being important to the general public in the study area. In any case, early interest group and public involvement activity is significantly related to greater consideration of environmental values in Survey Investigations.

With regard to the activities of environmental specialists in generating environmental information, substantial support was found for the *a priori* hypothesis that the consideration of environmental factors would be increased where these activities took place earlier in the planning process. Significant positive correlations were found between the formulation variable and measures reflecting early coordination between environmental specialists and conservation agencies and the public. Significant positive correlations were also found between the formulation variable and measures reflecting the early completion of environmental field studies and literature reviews and early completion of documentation of environmental information.

Some evidence was also found that the consideration of environmental factors may be enhanced where earlier attempts are made by environmental specialists to develop Environmental Quality (EQ) plans.* However, impressions gained as a result of the case study interviews suggest that unless careful attention is paid to the emerging EQ planning process, it can become a "tack-on", viewed only as another procedural obstacle to the implementation of plans formulated on technical and economic grounds.

Another area of interest investigated in this research was planner attitudes. An a priori hypothesis asserted that environmental information would be more influential in Survey Investigations conducted by study managers having more favorable attitudes toward the significance of environmental factors in planning. Two methods were used to assess these attitudes: Guttman scaling and the ECHO value assessment technique. However, neither method yielded results supporting the a priori hypothesis. It appears that the attitudes of a number of individuals, in addition to study managers, are influential in determining planning outcomes and that no relationship should be expected for the attitudes of any one of these individuals. Other attitudes, such as that toward the value of public involvement, appear to be potentially potent predictors of planning outcomes, and it may be fruitful to explore such attitudes in future research.

In an attempt to relate the various findings of this research regarding Survey Investigations to a logical causal structure, an exploratory multi-variate analysis using partial correlation was undertaken. The results of this analysis serve to highlight the importance of both individual citizens and interest groups and members of the Corps hierarchy to the consideration given environmental factors in pre-authorization planning. Multi-variate analysis showed that the positive, but non-significant, correlation between the formulation variable and a measure reflecting the extent to which environmental factors were considered an important local issue was dependent on the presence of extensive public and interest group involvement activities. This public and interest group involvement activity could thus be interpreted as an "intervening variable"; in other words, the translation of locally expressed environmental concerns into environmentally sensitive planning outcomes (as measured by the formulation variable) occurs through the public involvement process. Where there is a lack of public involvement, planning outcomes appear to coincide less with local environmental concerns.

---

*EQ plans are prepared, in response to Corps planning guidance, to highlight the ways in which environmental values might be enhanced while still meeting water resources needs.

Strong negative correlations noted between measures of the extent of public and interest group involvement activity and measures of increased hierarchical involvement in decision-making suggest that hierarchical influences might offset the influences of public involvement activities on planning outcomes. In fact, multi-variate analysis revealed that increased hierarchical control over decision making was acting as a "suppressor" of a significant positive correlation between the formulation variable and the measure reflecting the extent to which environmental factors were viewed as an important local issue. Where there was a lack of hierarchical involvement in decision making, planning outcomes appeared to coincide more with local environmental concerns.

The reason for this suppressing role of the hierarchy may relate to the need for Corps planners to achieve consensus with local sponsors in order for plans to move on to the project construction stage. Local environmental concern, when expressed as criticism and controversy, may be viewed as a threat to the achievement of consensus, motivating attempts by the District office hierarchy to limit participation in decision making to those interests which do not oppose plans on environmental grounds. Thus, attempts by interest groups to generate environmental controversy in Survey Investigations would appear to be counter-productive in terms of enhancing the relationship between local environmental values and planning outcomes.*

10.2 Advanced Engineering and Design Studies

The "modification variable" was used to characterize the consideration given environmental factors in post-authorization planning (i.e., Phase I "General Design Memorandum Studies" which are part of "Advanced Engineering and Design"). This variable reflects the extent to which modifications to a Congressionally authorized plan are motivated by environmental considerations and the extent to which modifications made to that plan alleviate adverse environmental effects.

The concepts examined for post-authorization planning studies were essentially the same as those examined in pre-authorization studies. However, the results of analysis reveal a substantially different emphasis in post-authorization planning. Overall, it appears that the consideration of environmental information in post-authorization planning depends to a much greater degree on the influences of interests outside the Corps, particularly other governmental agencies. Internal processes and working relationships between study managers and environmental specialists appear less important than was the case with pre-authorization planning.

With respect to organizational structure and processes, relatively little support was found for the *a priori* hypotheses relating planning outcomes (in this case the modification variable) to either increased authority of environmental specialists vis-à-vis the organizational structure or reliance on more informal and direct communications by study managers and environmental specialists. However, there was a significant positive correlation between the modification variable and the size ratio reflecting the proportion of environmental professionals to the total of all planners. If this size ratio can be viewed as a commitment by the District hierarchy to the increased use of environmental expertise in decision-making, then this correlation suggests that leadership by the District hierarchy may be important for the consideration of environmental factors in post-authorization planning. This leadership appears less important than in Survey Investigations, however, as is evidenced by the lack of a significant correlation between the modification variable and the index reflecting the breadth of responsibility assigned to environmental specialists. Other data suggest that a very important function served by environmental specialists in post-authoirzation planning is that of a liaison between environmental and conservation agencies and other Corps planners. Whether or not environmental specialists are encouraged to participate in formulating alternatives appears to be less important than in Survey Investigations.

---

*The findings of this research discussed above are in many ways consistent with postulates of bureaucratic behavior advanced by Downs (1967), particularly those postulates dealing with what Downs calls the "search" problem. Search refers to the seeking of solutions to perceived deficiencies in the performance of bureaus. Future research into environmental decision-making, at least that carried out by the Corps, might do well to use Downs' analytic framework as a point of departure.

A significant *negative* correlation was noted between the modification variable and the index reflecting increased reliance on informal communications mechanisms by study managers and environmental specialists. This finding, which is contrary to that predicted by the *a priori* hypothesis, may be explained by two factors. First, in post-authorization planning a significantly greater amount of written documentation is generally available than is the case in Survey Investigations and a somewhat greater dependence on these written sources instead of personal discussions could be expected. Second, in those studies where the modification variable had higher scores, a substantially greater amount of controversy surrounded the studies. In this atmosphere of increased pressure or scrutiny by outside interests there may be a greater concern by planners and environmental specialists to have their deliberations "on the record". In any case, the *a priori* hypothesis that more informal and direct communication between study managers and environmental specialists would be associated with the increased influence of environmental information on plan modification must be rejected. Similarly, the *a priori* hypothesis that environmental factors would have a greater influence on plan modification where environmental specialists have greater authority or status, although not rejected outright, appears to have less substantial support than was the case with Survey Investigations. All in all, the internal organizational arrangements used in carrying out post-authorization studies appear to be much less potent predictors of planning outcomes than they are in pre-authorization planning studies.

In contrast to the findings regarding organizational structure and processes, the influence of external coordination on planning outcomes appears stronger in post-authorization planning than in pre-authorization planning. Considerable support was found for the a priori hypothesis that a greater commitment to or extent of external coordination would be associated with the increased influence of environmental information on plan modification. Significant positive correlations were observed between the modification variable and measures reflecting the extent of coordination with conservation agencies and public involvement activity. It is noteworthy that agency coordination, and not interest group coordination (as was the case in Survey Investigations) is associated with the greater influence of environmental factors on planning outcomes. This is consistent with a general impression gained through the case study interviews that environmental and conservation agencies, at both the state and federal levels, were substantially involved in the studies where more significant environmental modifications were being made and, in fact, were the primary advocates of many of those changes. Perhaps these agencies feel more willing to provide a thorough substantive review of Corps proposals in this later stage of planning since a more clearly defined plan exists and the environmental effects of that plan can be more clearly delineated. The correlation noted between the modification variable and the measure of public involvement activity suggests that publics are also an important influence in the modification of plans in response to environmental concerns. Subjective impressions gained from the research as a whole are that, to a significant degree, the environmental advocacy of conservation agencies in post-authorization planning depends on a strongly expressed local concern over environmental issues. A significant correlation was also noted between the modification variable and the number of planning workshops, as opposed to formal meetings or hearings, utilized in post-authorization studies. Thus, the informal ambience of the workshop appears conducive to the creation of an effective dialogue between planners and environmentally concerned citizens in both pre- and post-authorization planning.

Further support for the view that environmental and conservation agencies exert a strong influence on post-authorization planning outcomes is found in analysis of measures reflecting the generation of new information.

Significant positive correlations were observed between the modification variable and the degree to which study managers gained new knowledge concerning constraints on projects or proposals from other agencies, interest groups and citizens. The correlation was especially strong with regard to information from agencies ($p < .01$). Furthermore, the more specific and constructive this information was perceived to be, the higher were the scores on the modification variable. These observations suggest very strongly that environmental and conservation agencies can have an important influence in plan modification by bringing pressure to bear on Corps planners to mitigate undesirable aspects of projects. The data indicate that citizens and interest groups are important sources of information on undesirable aspects of projects as well.

The effects of pressure exerted on planners regarding consideration of environmental issues by outside interests and members of the Corps hierarchy was explicitly investigated to test the a priori hypothesis that greater amounts of such pressure would be associated with greater consideration of environmental factors in plan modification. Substantial support for this hypothesis is reflected in the significant positive correlations that were found between the modification variable and variables characterizing the extent of environmental controversy present in the study and the extent of environmental criticism from other agencies, from interest groups, and from citizens. Modification variable scores were also notably (although not statistically significantly) higher in the five post-authorization studies where study managers felt there was a significant threat of environmental litigation. These findings lend clear support to the notion that greater pressure exerted on planners by environmental interests (i.e., agencies, groups, and citizens) can lead to a greater degree of consideration of environmental factors in decision making during post-authorization planning.

Another area of interest examined in the research was the relationship between planner attitudes and planning outcomes. An a priori hypothesis asserted that environmental considerations would influence plan modification to a greater degree in studies managed by planners having more favorable attitudes toward environmental concerns. As discussed above in connection with Survey Investigations, this investigation of attitudes relied on two methods, Guttman scaling and ECHO value assessment, to arrive at measures of attitudes toward environmental concerns. No significant correlations were found, however, between the modification variable and these two measures of attitude, leading to rejection of the a priori hypothesis. The primary reasons for this lack of relationship appear to be the influence of other individuals on planning outcomes and the confounding effects of competing attitudes, e.g., those toward the value of public involvement.

In an attempt to relate the various findings of this reasearch regarding post-authorization (Phase I) planning to a logical causal structure, an exploratory multi-variate analysis using partial correlation was undertaken. The results of this analysis serve to highlight the importance of a "constituency" of environmental interests to the influence of environmental and conservation agencies on the consideration given environmental factors in post-authorization planning. Multi-variate analysis showed that the strong positive correlation between the modification variable and a measure reflecting the extent to which environmental factors were considered an important local issue was not dependent on the presence of extensive interest group or public involvement activities. Thus, in contrast to the situation in Survey Investigations, the translation of local environmental concerns into planning outcomes that reflect environmental factors (as measured by the modification variable) does not appear to occur to a significant degree through the public involvement process. General impressions gained through the research as a whole are that such local concerns influence post-authorization planning outcomes much more directly by means of political leverage that is applied through the involvement of environmental and conservation agencies.

A general impression gained from the case study interviews was that a constituency of environmental interests (both groups and individual citizens) often prompted environmental and conservation agencies to become advocates of modifications to Corps proposals. To determine whether such a view could be supported empirically, multi-variate analysis was carried out to ascertain whether the influence of other agencies over post-authorization planning outcomes was contingent on expressions of local environmental concern. The initially strong positive correlation between the perceived influence of other agencies over four fundamental areas of decision making (problem definition, alternative formulation, impact assessment, and plan selection) and the modification variable was substantially lower in situations in which there was a lack of local concern over environmental issues. This observation lends support to the notion that environmental and conservation agencies may be responding to their constituencies of environmental interests when they become involved in post-authorization planning as advocates of change.

The reasons for this advocacy based on constituency support may relate to what Ingram (1973) has described as the breaking down of the traditional decision rules of "mutual accommodation" and "noninterference" between the Corps and EIS reviewing agencies. The growing "political capital" of environmental interests stemming from NEPA and other environmental legislation has made it harder for environmental and conservation agencies to ignore demands made by these environmental interests on the Corps. In fact, environmental interests may, in a sense, "enlist" conservation agencies as advocates, viewing them as a more legitimized channel of influence than that provided by traditional public involvement activities, particularly in the late stages of planning.*

10.3 Policy Implications

The research findings discussed above suggest several ways in which the increased consideration of environmental factors in Corps planning and decision making might be achieved. These policy implications involve actions which might be taken by the Corps itself and also actions which might be taken by other agencies and interests outside the Corps. The discussion below should not be interpreted as an exhortation of what the Corps and other agencies should or should not do but rather as an indication of areas which might be given further attention if the Corps and other agencies and interests desire to put increased emphasis on the extent to which environmental factors influence decision making.

---

*The apparent ability of direct political leverage rather than "grass roots" involvement to influence post-authorization planning is also consistent with certain postulates of Downs (1967) regarding bureaucratic behavior. As planning progresses ever nearer to actual project construction, environmental interests may raise louder and louder "alarms" which the Corps, if it desires to see projects implemented, must heed. This process is similar to the process of bureaucratic change discussed by Downs.

Corps of Engineers

One of the principal findings of the research concerned importance of interests outside the Corps (i.e., other agencies, interest groups, and citizens) to the effective development of environmental information in Corps planning studies. The advantages of various methods for coordinating with or involving these interests in the planning process are extensively discussed in the literature (see, e.g., Bishop (1970) or Erickson (1976)). Although no one technique for such involvement could be expected to be applicable in all situations, the findings of the analysis of both pre- and post-authorization planning studies point out the value of using the planning workshop as a device for encouraging dialogue between planners and concerned agencies and publics. By avoiding the formality and authoritarian ambience typical of traditional public hearings, the workshops allow for more personal, informal communication between participants. This increased dialogue appears to enhance the generation and utilization of environmental information in decision making. Although the research did not specifically address the procedures used in conducting planning workshops, insights gained from the comments of several study managers provide the following suggestions regarding workshop techniques: (1) a specific set of agenda items should be used to provide a focus for the meetings; 2) the size of workshops should be limited to a "manageable number" of people, although care should be taken to ensure that all relevant interests are represented; 3) audio-visual aids, such as slide presentations and large flip charts, should be used to make presentations more understandable; and 4) short questionnaire forms can be used to stimulate discussion and provide other useful insights. Study managers using workshops generally felt that they were superior to traditional public meetings in generating useful dialogue between planners and concerned citizens as well as with interest groups and agencies. Given these evaluations of the utility of planning workshops and the observed correlations between their use and the increased influence of environmental factors on planning outcomes, it appears that efforts to develop workshop skills among planners represent a promising investment. Reliance on any single technique for information gathering, however, is not recommended Each planning situation is somewhat unique and requires an individually designed program of public involvement activities (Corps, 1976).

The timing of agency and public involvement and of the development of environmental information through field study and documentation is another aspect of this research that has potential policy implications for the Corps. Although Corps regulations have long directed and encouraged the early involvement of agencies and publics and the early identification of environmental problems, present practices often result in agency review of EISs late in the pre-authorization planning process and the delay of environmental field work until after feasible plans have been identified; these practices tend to diminish the influence of environmental information on plan formulation since such information is often generated after a particular plan or concept has been tentatively selected. The following are among the several possible ways in which current practices could be modified in the direction of encouraging the consideration of environmental factors relatively early in the planning process:

1) The circulation of information concerning environmental aspects of the investigation to a wide range of publics and agencies could be required early in the planning process, before work begins on the draft EIS. This information could be provided in the form of brochures or booklets that do not require formal "review and comment" procedures; it would be useful, however, to encourage public and agency response.*

2) Study managers could be encouraged to hold planning workshops or other informal meetings early in the planning process to provide maximum opportunities for public inputs and agency comments to influence the formulation of alternative actions; such meetings could focus specifically on local environmental concerns or the identification of potential impacts.

3) Environmental specialists could be encouraged to provide early inputs into the planning process by participating in workshops, such as those described above, or by preparing pre-draft EIS environmental information. Preliminary field studies could also be required prior to the checkpoint 1 conference, and environmental specialists could be encouraged to participate in these review conferences.

---

*For an example of the use of such brochures, see the description of planning in the San Pedro Creek study provided by Ortolano and Wagner (1977).

Clearly, new regulations* or procedural guidance encouraging timely development of environmental information are without much value unless they are put into actual practice. The leadership of the Corps hierarchy, particularly at the District level as discussed below, is essential for effective implementation.

In those few Survey Investigations where interdisciplinary planning teams were formally established, a greater influence of environmental factors on the formulation of alternatives was noted. Furthermore, the findings of the research indicating the importance of citizens and interest groups in identifying environmental issues of concern suggest that an even greater amount of environmental information could be developed and incorporated into planning outcomes if interdisciplinary teams included citizens as members. There are many precedents for the extensive use of interdisciplinary teams with citizen members in the U.S. Bureau of Reclamation; as elaborated by Price and Ortolano (1978), the use of teams that meet frequently and have a broad range of members (including citizens and representatives of other agencies) is associated in a statistically significant way with Bureau of Reclamation feasibility investigations in which environmental factors received extensive consideration in the formulation of alternatives. These observations, together with the results noted above in Section 5.2 concerning informal, interactive communication, indicate that interdisciplinary planning may have advantages in terms of increasing the consideration given to environmental factors in Survey Investigations.** The fact that interdisciplinary planning within the Corps appears to be the exception rather than the rule (despite procedural guidance to the contrary) suggests that further attention to practical implementation of interdisciplinary planning methods may be appropriate.

---

*The findings of this research regarding the timing of the development of environmental information through early public involvement and environmental documentation also support the tone of the CEQ's proposed new regulations which emphasize these timing issues (CEQ, 1978). These new regulations, if implemented, should encourage the Corps to achieve the early involvement of agencies and publics and the early development of environmental information by environmental specialists shown above to be associated with the increased influence of environmental information on the formulation of alternative plans.

**Some of the potential difficulties in using interdisciplinary planning in Corps studies are elaborated by Wagner and Ortolano (1976).

As far as Corps administrative policy is concerned, one of the most important findings of the research reported herein is the importance of the District hierarchy, particularly District Engineers and Engineering Division and Planning Branch Chiefs, in providing leadership encouraging increased consideration of environmental factors in planning. This leadership appears to be exerted in two ways. It can provide planners with support for the consideration of environmental factors through District level policy commitments encouraging a greater participation of environmental specialists in all phases of planning and through commitments of actual planning resources to environmental matters, as reflected in a proportionately larger environmental staff. On the other hand, it can lessen the degree to which environmental information actually influences decision making by exerting increased hierarchical control over decision making. This constraining influence of hierarchical control deserves elaboration.

Increased hierarchical control over decision making, particularly the control exerted by the District Engineer, appears to be partly a reaction to controversy and criticism from environmental interests. This controversy and criticism may be perceived as a threat to the ability of the Corps to achieve consensus with local sponsors allowing the favorable recommendation and ultimate implementation of water resources projects. Furthermore, three study managers participating in interviews concerning Survey Investigations felt that personnel evaluations for professional advancement within the Corps were based, in part, on the ability of planners and their superiors to produce plans that are economically justifiable, politically acceptable, and implementable by the Corps. (As noted above in Section 9.1, the implementation of plans is essential to the social effectiveness of the Corps.)

These observations suggest that the consideration given to technical and economic feasibility considerations in planning rests on an issue fundamentally more important to planners and their superiors (namely, their opportunities for advancement) than does the consideration given to environmental factors. Thus, if Corps policy makers wish to enhance the consideration of environmental factors in planning, the evaluations of the performances of individuals doing that planning could be changed in the direction of increasing the rewards (e.g., advancement, salary) that can be obtained by planners who give greater emphasis to environmental considerations in planning. Clearly, good planning must, in some sense, represent a balancing of social, economic, and environmental values. The discussion above suggests that present decision-making may be directed so heavily by economic and political factors that it is difficult for environmental factors to receive appropriate consideration. If professional advancement was contingent upon performance with regard to environmental quality considerations rather than primarily with economic and technical feasibility factors, as appears often to be the case presently, a greater attention to environmental factors could be expected from planners and their superiors.

Reviewing Agencies and Interest Groups

The findings of this research indicated the importance of environmental and conservation agencies and interest groups to the effective development of environmental information in pre- and post-authorization planning. However, the influence of agencies in the early stages of planning was generally limited. It appears that the reluctance of agencies to expend resources in reviewing Corps proposals until those proposals are quite specific represents a loss of opportunity to influence the process of alternative formulation. Late stage involvement of other agencies is, however, partly the result of regulations and practices which emphasize inter-agency review of plans at a late stage in the planning process, i.e., after a preliminary draft EIS addressing a proposed action has been prepared. If substantive involvement of other agencies could be effected earlier in the planning process (e.g., through participation of members of other agencies on interdisciplinary teams, or through informal conferences with representatives of other agencies held early in Survey Investigations) an increased influence of environmental considerations on plan formulation might result.

Early involvement of interest groups in the generation of environmental information was found to be strongly related to the increased consideration of environmental factors in Survey Investigations. The research findings also suggest that the most effective way for interest groups to influence the plan formulation process is to identify and present to planners information regarding project impacts in a factual and specific format. When information is presented as criticism and in a general (as opposed to specific) form, it appears to have less of a likelihood of encouraging the consideration of environmental factors. These observations suggest that interest groups may enhance the consideration given environmental factors in the formulation of alternative plans by bringing potential concerns to the attention of planners at the outset of Survey Investigations and by backing up these expressed concerns by providing factual descriptions of potentially affected resources.

Another research finding that is relevant to the strategies adopted by environmental interest groups concerns the notion that Corps planners appear to accommodate environmental concerns when they perceive that these concerns are widely held (i.e., that they are not just the concerns of a small, "unrepresentative" minority). Thus it appears that, at least in Survey Investigations, an attempt by interest groups to educate the local public about possible adverse effects of proposals represents an effective way to enhance the consideration given environmental factors. However, the documentation of adversely affected environmental resources and education of the public about these resources will undoubtedly strain the manpower and budget of most locally organized groups. Coordination between such local groups and larger national citizen based environmental organizations having more substantial financial and human resources, might reveal ways in which the documentation of effects on environmental resources and education of the public about these effects could be achieved economically.

With regard to planning which is in the later stages, i.e., post-authorization planning, both agencies and interest groups appear to be effective in influencing the plan modification process by means of criticism that places pressure on the Corps. Furthermore, a coalition of environmental agencies and the interest groups making up their "constituencies" appear to be very influential in effecting plan modifications in response to environmental considerations. In this regard, it would appear that a useful strategy for interest groups would be to cultivate relationships with environmentally oriented agencies and maintain communication with these agencies regarding particular planning studies of interest.

Finally, observe that interest groups also appear to be influential in effecting the modification of an authorized plan by using the threat of litigation. If the courts continue to entertain suits regarding substantive rights under NEPA (i.e., requirements that federal agency proposals satisfy NEPA's goals as described in Section 101 of the Act) then this channel of influence will become more established. On the other hand, if the courts emphasize the view that NEPA grants only procedural rights (i.e., the requirements for a timely and thorough assessment of impacts) then it is likely that the use of NEPA based court action will decrease in significance since the requirement for procedurally adequate EISs will be attained more and more frequently by the Corps as time goes on.

10.4 Directions of Future Research

The findings and interpretations of the research described herein suggest several areas of environmental decision making where further study may be fruitful. The multi-variate analysis of Chapter Nine suggests two general frameworks which could be used to guide such research efforts.

Future research could benefit from adoption of the "resource dependence" framework suggested by Pfeffer and Salancik (1978) as a framework that is appropriate for analysis of the external control of organizations. The resource dependence perspective views organizational effectiveness as "an external standard of how well an organization is meeting the demands of the various groups and organizations that are concerned with its activities." (Pfeffer and Salancik, 1978, p. 11). The focal organization (e.g., the Corps) is effective when it utilizes inputs from and generates outputs for the other groups and organizations on which it depends for resources or approval in a way acceptable to those groups and organizations. In the present research the Corps can be seen as dependent primarily on the Congress (for funding) and local sponsors and other agencies (for approval). The resource dependence perspective asserts that the nature of the external dependencies of the focal organization determines the form of the information gathering system used in decision making. Information from non-dependent organizations or groups is less likely to be actively pursued and thus less likely to influence decisions. If external dependency thus determines the degree to which information from various groups is solicited and utilized, future research into Corps of Engineers' decision making might examine the ways in which environmental interests make the Corps dependent upon them for resources or approval. The threat of litigation, shown to be effective in eliciting plan modifications in response to environmental concerns, represents one way in which environmental interests may induce such dependence, and the emerging ties between environmental interest groups and conservation agencies (on which the Corps may depend for favorable review of its decisions) may represent another. Future research might also address the ways in which existing dependencies are utilized to encourage environmental information gathering (e.g., through lobbying of Congressmen by environmental interests).

Another analytic framework which appears useful to the study of environmental decision-making by the Corps, and which is, in fact, compatible with the resource dependence perspective discussed above, is provided by Downs' (1967) postulates of bureaucratic behavior. Central to Downs' framework is the thesis that the social function of a bureau (in the case of the Corps, the social function is the distribution of Federal economic benefits through the construction of water resource projects) greatly affects its structure, and, furthermore, has a profound influence on decision making. The apparent suppressing role of hierarchical control in the incorporation of environmental concerns in Survey Investigation outcomes can be viewed, from Downs' perspective, as an organizational attempt to ensure that controversy or criticism from environmental groups does not stand in the way of the effective accomplishment of the Corps social function. Future research could address the degree to which demands for the preservation and enhancement of environmental quality are perceived as being inimical to the social function of the Corps and the effect that this perception has on the degree to which those demands are accommodated.

Although the resource dependence perspective of Pfeffer and Salancik (1978) generally attributes little influence to administration, both the evidence reported herein and the postulates of Downs' (1967) suggest that, in the Corps, hierarchical influences over decision making may be substantial. Furthermore, remarks made by several participants in the case study interviews suggest that these hierarchical influences may stem from both organizational and personal goals. The degree to which demands relating to environmental quality are accommodated may thus depend on their perceived effect on both the social function of the organization and on the career interests of decision makers, who may be evaluated on the basis of their ability to implement water resources projects. Future research might examine the influence of members of the Corps hierarchy over environmental decision making and attempt to relate that influence to the career goals of those individuals. In the same vein, future research into the ways in which personnel evaluations could be altered to reflect changing organizational goals (e.g., the raising of "environmental quality" to the status of a national planning objective) may also be fruitful.

The research presented herein did not set out to explicitly examine interdisciplinary planning or its relation to planning outcomes. However, many of the findings of the research suggest that interdisciplinary planning which includes environmental disciplines may result in planning outcomes that are sensitive to environmental values. In Survey Investigations where environmental specialists were encouraged to participate in the formulation of alternatives and where communications between study managers and environmental specialists were characterized by greater frequency, more feedback, and more frequent expression of innovative ideas, significantly greater consideration was given to environmental factors. Future research efforts might fruitfully examine the degree to which interdisciplinary planning takes place and attempt to relate this to the environmental sensitivity of planning outcomes. As a starting point, determination of the degree to which interdisciplinary planning takes place might consider the following as attributes of interdisciplinary planning:

1) Communications--frequent informal communication between participants and extensive feedback and expression of innovative ideas by all participants.

2) Group Meetings--frequent meetings at which a variety of disciplines are represented and all participants are encouraged to express their views.

3) Decision-Making--representatives from all disciplines feel that they have had the opportunity to influence the outcomes of traditional planning tasks (i.e., problem definition, alternative formulation, impact assessment, and plan selection).

This is not, of course, an exhaustive list of attributes that can be used to characterize interdisciplinary planning and careful research may reveal additional attributes. Successful interdisciplinary planning may also depend a great deal on the group leadership skills of study managers and other supervisors and on the degree to which the interdisciplinary planning team *per se* can be integrated into established management procedures.

A principal finding of the sample of post-authorization studies discussed herein was the substantial influence of conservation agencies supported by constituencies of environmental interests. As traditional "decision rules" such as "mutual accommodation" and "noninterference", which have characterized Corps-agency relations in the past break down,* conservation agencies may, to a greater and greater degree, become influential advocates of the views of constituencies of citizens concerned with environmental quality issues. Recent Congressional failure to override President Carter's veto of the so-called "pork-barrel" water projects bill may hasten this process, since the power of the Presidents' appeal was based, in part, on good working relationships established between the Administration and various environmental groups (National Wildlife Federation, 1978). Future research into these emerging relationships between environmental groups and conservation agencies might attempt to relate the degree to which agency and group concerns are synthesized into coherent demands which are made of Corps planners and the degree to which the environmental values reflected in such demands are addressed by Corps decision-making.

---

*According to Ingram (1972), "mutual accommodation" comes about because conservation and recreation agencies may gain more politically by advocating rather than opposing Corps proposals. "Noninterference" refers to the practice, by conservation agencies, of not becoming involved in Corps projects in which they do not have a direct interest.

APPENDIX A

VARIABLE DEFINITIONS, MEASUREMENTS AND SCORING*

The objective of this investigation is to ascertain the extent to which environmental factors are considered in the water resources planning process of the U.S. Army Corps of Engineers. If such consideration occurs, it is anticipated that the influence of environmental information would be most strongly reflected in three activities of the planning process: 1) Formulation of alternatives, 2) Ranking of alternatives, and 3) Modification of a tentatively selected plan. How extensively environmental factors influence these "dependent" variables will be determined by characteristics of a particular agency's decision making procedure. On the basis of previous research (see Sections 1.1 and 1.2) the following four characteristics, or sets of "independent" variables, were selected for study in this investigation: (1) Organizational Structure, (2) Attitudes, (3) External Coordination and (4) Timing of Environmental Activity. Each of these sets includes several variables which are defined, measured and correlated with the dependent variables.

This appendix discusses in detail each of the variables examined in this research, beginning with the dependent variables. Each variable is first described and defined in conceptual terms. The interview questions used to measure the variables are then presented and a scoring system for transforming verbal responses into numerical values is outlined. Note that in actual field interviews the order of questioning was significantly different from that presented here. Also, it was not always necessary to ask each question explicitly since a single question often elicited responses to several other related questions.

---

*Format and contents of this appendix are adapted from "Design of Research Dealing with the Corps of Engineers" by Charles Brendecke and Leonard Ortolano, Department of Civil Engineering, Stanford University, unpublished, 1976.

A.1 DEPENDENT VARIABLES

Formulation Variable

One of the dependent variables measured for the sample of preauthorization studies examined in this investigation was the influence of environmental information on the formulation of alternative plans (referred to as the "formulation variable").

Conceptual Definition--The consideration of environmental factors may serve either of two functions in the process of formulating alternatives. In some cases such consideration may lead to establishing goals or objectives (e.g., water quality criteria for chloride removal) which each alternative must satisfy. In other cases environmental considerations may suggest constraints on the range of possible alternatives (e.g., the existing reef environment shall not be disrupted). Thus, environmental considerations influence the formulation of alternatives to the extent that these environmental objectives and constraints influence the alternatives that are considered in the planning process; this provides the conceptual definition of the formulation variable.

Operational Definition--Measurement of the formulation variable began with the identification of the objectives and constraints which were influential in the planning study. The following series of questions were asked of the study manager:

> "For the purpose of answering the next series of questions, two definitions must be agreed upon. Let's define planning objectives as the defined purposes or goals toward which planning effort is directed: thus, flood protection, fish and wildlife enhancement or improvement of navigation may be considered planning objectives. Let's define planning constraints as aspects of the setting of any plan which force or produce adaptations or accommodations in that plan: thus, the need for conformance with a land use plan, the need for economic justification, the need to provide minimum flows, all may be seen as planning constraints."

Q1. "Are these definitions clear and acceptable to you?"

IF NOT, LOCATE SOURCE OF DISAGREEMENT

Q2. "What were the planning objectives defined at the outset of the study?"

Q3. "Were any new objectives defined after work was begun?"

Q4. "If so, what were those objectives?"

Q5. "When were they developed?"

Q6. "What were the planning constraints that were identified at the outset of the study?"

Q7. "Were any new constraints identified after work was begun?"

Q8. "If so, what were those constraints?"

Q9. "When were they identified?"

The next step in measuring the formulation variable was the identification of the alternative plans which had been given detailed study during the course of the Survey Investigation. These were ascertained by asking the study manager the following series of questions:

> "It is often the case in studies such as (name of study) that quite a large number of alternative plans are developed early in the study. These alternatives are then subjected to a screening process which eliminates those that obviously do not meet planning objectives or are infeasible. The reduced range of alternatives remaining are then given detailed study."

Q10. "Did a screening exercise such as this occur in this study?"

IF NOT, GO TO Q17.

Q11. "When did this occur?"

Q12. "How many alternative plans were subjected to the screening?"

Q13. "After this screening, how many alternatives remained for detailed study?"

Q14. "Were new alternatives subsequently developed which were given detailed study as well?"

Q15. "If so, how many?"

Q16. "Could you briefly describe these alternatives which were given detailed study?"

GO TO Q19.

Q17. "How many alternative plans were given detailed study?"

PROBE: COST/BENEFIT STUDIES?

Q18. "Could you briefly describe these alternatives which were given detailed study?"

The alternatives thus identified were then listed down the left side of each of the two formulation matrices shown in Figure A-1 and Figure A-2. Across the top of the first matrix, Figure A-1, were listed the planning objectives described in questions Q2 through Q5. Across the top of the second matrix, Figure A-2, were listed the planning constraints described in questions Q6 through Q9. These two matrices were then given to the

FIGURE A-1
ACHIEVEMENT OF PLANNING OBJECTIVES

Please indicate the extent to which the alternative plans achieve the planning objective.

Provides No Achievement	Provides Limited Achievement	Objective Moderately Achieved	Objective Largely Achieved	Highest Possible Achievement
1	2	3	4	5

Planning Objectives

Alternatives Given Detailed Study	Flood Damage Reduction	Hydro-electric Power	Enhance Fish and* Wildlife			
Alternative A	4(1)	5(1)	4(1)			
Alternative B	5(1)	3(1)	2(0)			
Alternative C	3(1)	3(1)	4(1)			
Alternative D	2(0)	1(0)	1(0)			
Σ (dichotomized scores)	3	3	2			

$$\frac{\Sigma \text{ environmental objectives}}{\Sigma \text{ all objectives}} = \frac{2}{3 + 3 + 2} = .25 = \text{"Objective score"}$$

Note: Asterisks, dichotomized scores, and score computation example did not appear on forms used in field interviews.

FIGURE A-2

INFLUENCE OF PLANNING CONSTRAINTS

Please indicate the extent to which the constraints have influenced the form of the alternative plan.

Form Not at All Influenced	Form Somewhat Influenced	Form Moderately Influenced	Form Greatly Influenced	Form Completely Dictated
1	2	3	4	5

Planning Constraints

Alternatives Given Detailed Study	Show Economic Feasibility	Avoid Parkland* Disruption	Maintain* Water Quality	Unstable Foundation Material		
Alternative A	4(1)	1(0)	3(1)	2(0)		
Alternative B	2(0)	3(1)	2(0)	5(1)		
Alternative C	2(0)	2(0)	2(0)	4(1)		
Alternative D	5(1)	3(1)	1(0)	1(0)		
Σ (dichotomized scores)	2	2	1	2		

$$\frac{\Sigma \text{ environmental constraints}}{\Sigma \text{ all constraints}} = \frac{2+1}{2+2+1+2} = \frac{3}{7} = .43 = \text{"Constraint Score"}$$

FORMULATION VARIABLE SCORE:

	"Objective Score"	.25
+	"Constraint Score"	+ .43
	Formulation Score =	.68

Note: Asterisks, dichotomized scores, and score computation example did not appear on forms used in field interviews.

study manager with the following instructions:

> Q19. "Using the information generated so far I have constructed two charts. This one (HAND FORM) lists the alternatives which have been given detailed study down the side and the planning objectives across the top. Using an appropriate number from the scale provided at the top of the chart, would you indicate, for each objective, the extent to which the various alternatives achieve the objective. If you feel that some alternative does not apply to a particular objective, you may leave the appropriate box blank."

> Q20. "This chart (HAND FORM) lists the alternatives down the side and the planning constraints along the top. Using an appropriate number from the scale provided at the top of the chart, would you indicate, for each alternative, the degree to which the various constraints have influenced the form of the alternative. If you feel that some constraint does not apply to a particular alternative, you may leave the appropriate box blank."

Prior to scoring the data provided by study managers in Figures A-1 and A-2, project documentation was consulted to verify that the objectives and alternatives entered on the two matrices had, in fact, been seriously addressed in the planning studies. Where such evidence from written records or corroborative testimony from environmental specialists was not available, those particular objectives, constraints, and alternatives were not considered in the scoring procedure.

Scoring: Formulation Variable--Alternatives are formulated to satisfy both environmental and non-environmental objectives and constraints. In scoring the formulation variable, we are interested in determining the relative importance of environmental objectives and constraints in the formulation of alternatives. (Section 4.1 above provides a discussion of how "environmental" is defined for purposes of this research.)

Data in the formulation matrices (e.g., Figure A-1) are used to score the formulation variable according to the procedure described below. First the objectives and constraints listed across the top of the formulation matrices were classified, by the researcher, as "environmental" or "non-environmental". Examples of typical objectives and constraints are provided in Figures A-1 and A-2, with those classified as "environmental" denoted by asterisks. Next all the ordinal values entered in the matrices were converted to 0-1 dichotomies; all values of 3 or greater being converted to 1's and values of 1 or 2 converted to 0's. The numbers in parentheses in Figures A-1 and A-2 are dichotomized versions of the example ordinal scores of the hypothetical study manager. Next the dichotomized scores for each objective and constraint were summed vertically (across all alternatives). For the objective matrix, Figure A-1, the "objective score" was computed as the sum of dichotomized scores for environmental objectives divided by the sum of dichotomized scores for all objectives. Similarly, in Figure A-2, a "constraint score" was computed as the sum of dichotomized scores for all environmental constraints divided by the sum of dichotomized scores for all constraints. The final score used for the formulation dependent variable was then defined as the sum of the "objective score" and the "constraint score". In the hypothetical example provided in Figures A-1 and A-2, the formulation variable attained a score of 0.68 out of a maximum of 2.0.

Ranking Variable

A second dependent variable measured for the sample of pre-authorization studies examined in this investigation was the influence of environmental information on the ranking (or comparison) of alternative plans (referred to as the "ranking variable").

Conceptual Definition--Consideration of environmental factors may influence the comparison of alternatives by helping decision makers evaluate the relative advantages and disadvantages of particular plans. This influence will be evident to the extent that environmental factors are introduced, studied and discussed in the context of comparing alternatives during such activities as team meetings, inter- or intra-agency coordination, public hearings and the like. Used in this way, environmental information clarifies the values and interests of affected persons, providing decision makers with criteria upon which to base their selection of an alternative plan. Measurement of the ranking variable consisted of determining the importance of environmental considerations relative to all considerations in the ranking of alternative plans.

Operational Definition--The range of factors, environmental and otherwise, generally considered in the ranking of alternative plans for Corps water resources planning studies are shown in Figure A-3. The influence

FIGURE A-3

SELECTION OF PLAN

Please indicate the degree to which each factor influenced the choice of the selected plan.

		Degree of Influence					
		None	Limited	Moderate	Large	Most Dominant	Dichotomized Score
1.	Acceptability to the local sponsor.	1	2	3	4	5	1
2.	Economic efficiency.	1	2	3	4	5	1
3.	Extent to which problems and needs are satisfied.	1	2	3	4	5	1
4.	Balance of capital and recurrent cost.	1	2	3	4	5	1
5.	Availability of water.	1	2	3	4	5	0
*6.	Cultural or social impacts.	1	2	3	4	5	1*
7.	Acceptability to Congress.		2	3	4	5	0
*8.	Environmental benefits.	1	2	3	4	5	1*
*9.	Water quality effects or standards.	1	2	3	4	5	0*
10.	Acceptability to other agencies.	1	2	3	4	5	0
*11.	Historical/Archeological considerations.	1	2	3	4	5	0*
*12.	Air quality effects or standards.	1	2	3	4	5	0*
*13.	Fish or wildlife impacts.	1	2	3	4	5	1*
14.	Acceptability to the Division or OCE.	1	2	3	4	5	1
*15.	Land use impacts.	1	2	3	4	5	0*
16.	Other (non environmental)				4		1
*17.	Other (environmental)				4		1*

$$\frac{\Sigma \text{ dichotomized scores for environmental factors}}{\Sigma \text{ dichotomized scores for all factors}} = \frac{4}{10} = 0.4 = \text{"Ranking Score"}$$

Note: Asterisks, dichotomized scores, and score computation example did not appear on forms used in field interviews.

of environmental considerations on the ranking of alternative plans is measured by means of the following question (asked of the study manager):

> Q21. "This table (HAND FORM) lists various factors and considerations which may or may not have been influential in the decision to choose the recommended plan. Could you read through the list and tell me if any factors which were significant in this decision have been left out? (ADD NEW FACTORS TO LIST). Now, using the scale provided, would you indicate the degree to which each factor influenced the decision to choose the recommended plan."

Prior to scoring the responses to question Q21, all ordinal scores were converted to 0-1 dichotomies; all values of 3 or greater being converted to 1's and values of 1 or 2 converted to 0's. The numbers in the far right-hand column of Figure A-3 represent the dichotomized versions of the example responses provided.

Scoring: Ranking Variable--The score for the ranking variable is computed as the sum of the dichotomized scores for environmental factors (indicated by asterisks on Figure A-3) divided by the sum of the dichotomized scores for all factors. Factors added by the respondent (last two items in Figure A-3) were classified as "environmental" or "non-environmental" by the researcher and included in the index accordingly. (Again, note that Section 4.1 above contains a discussion of criteria used to define "environmental.") In the example provided the ranking variable assumes a value of 0.40 out of a maximum of 1.0.

Modification Variable

The dependent variable measured for the sample of post-authorization studies examined in this investigation was the influence of environmental information on the modification of a proposed plan (referred to as the "modification variable").

Conceptual Definition--The influence of environmental information on the modification of a proposed plan is evident in the extent to which changes or alterations made in the proposed (i.e., Congressionally authorized) plan are brought about by environmental considerations and the extent to which these changes alleviate adverse environmental effects associated with the proposed plan. The measurement of the modification variable consisted of: 1) determining the types of modifications made to Congressionally authorized plans during post-authorization planning and the factors leading to those modifications, and 2) describing the adverse environmental effects of the authorized plans and evaluating the extent to which modifications made during post-authorization planning alleviate each of those adverse effects.

Operational Definition--The types of modifications made to authorized plans were ascertained using the following questions, asked of the study manager:

> "The following series of questions deals with the ways in which the authorized plan has been modified during Phase 1 planning."
>
> Q22. "Does the project as presently envisioned differ in any major ways from the project as authorized?"
>
> Q23. "Has a PACR been filed with OCE for this study? If so, when was it filed?"
>
> Q24. "Could you briefly describe the major changes or modifications that have been made to the authorized plan?"
>
> Q25. "What, if any, minor changes or modifications have been made to the project as authorized?"
>
> PROBE FOR MOST MINOR OF CHANGES

The changes or modifications described were then verified by consulting the section of the project report (i.e., Phase 1 GDM) dealing with "Departures from the Authorized Plan" and, in the case of significant modifications, the Post Authorization Change Report (PACR). Modifications identified in these sources and in response to questions Q23 through Q25 were then listed across the top of a "modification matrix" shown in Figure A-4. Study managers were then given this matrix and asked:

> Q26. "This chart (HAND FORM) lists factors or considerations which may or may not have been influential in producing the changes or modifications you have described. Would you read down the list and tell me if any factors which were influential in producing these changes have been left out. (ADD ANY NEW FACTORS). Now, using an appropriate number from the scale at the top of the chart, would you indicate, for each change or modification, the degree of influence the various factors have had in producing that change."

Study managers were then asked the following questions:

FIGURE A-4

MODIFICATIONS TO AUTHORIZED PLAN

Please indicate the degree of influence the factors have had in producing each of the modifications indicated.

No Influence	Small Influence	Moderate Influence	Large Influence	Most Influential Factor
1	2	3	4	5

	Plan Modifications			
Factors Producing Change	Change Levee Alignment	Purchase Additional Habitat	Delete Water Supply Purpose	Σ of Dichotomized Scores
Increased detail of study	5(1)	3(1)	2(0)	= 2
Changing economic conditions	1(0)	2(0)	5(1)	= 1
New engineering problems	4(1)	1(0)	1(0)	= 1
Local opposition	1(0)	4(1)	4(1)	= 2
Agency opposition	2(0)	4(1)	4(1)	= 2
Changing planning regulations	1(0)	2(0)	2(0)	= 0
*Air/Water quality standards	1(0)	1(0)	1(0)	= 0*
*Adverse social impacts	1(0)	2(0)	2(0)	= 0*
*Adverse environmental impacts	1(0)	5(1)	1(0)	= 1*
Congressional interest	1(0)	2(0)	3(1)	= 1
				10 Grand Total

$$\text{"Motivation Score"} = \frac{\Sigma \text{ of dichotomized scores for environment factors}}{\Sigma \text{ of dichotomized scores for all factors}} = \frac{0+0+1}{10} = 0.10$$

"For the purpose of answering the next few questions, let us define environmental effects as those effects which a project may have on air or water quality, ecology, fish or wildlife habitat, archeological or historical resources, aesthetics, recreation, land use and open space, or community cohesion. These aspects of the environment are those typically found in, but not limited to, the EQ and SWB accounts of the Principles and Standards."

Q27. "Is this definition of environmental effects clear and acceptable to you?"

CLARIFY IF NECESSARY

Q28. "Could you describe the adverse environmental effects, if any, of the authorized project?"

PROBE FOR MINOR EFFECTS

The adverse effects described in question Q28 were then listed down the left side of the form shown in Figure A-5. The study manager was then given this form and asked:

Q29. "This chart (HAND FORM) lists the adverse environmental effects you have just described. Using the scale provided, would you indicate the degree to which the project as presently envisioned has alleviated each of the adverse environmental effects. In considering degree, try to account for any adverse effects which the present plan may have. That is, indicate the net alleviation of adverse effects accomplished by the plan as now envisioned."

Both Figures A-4 and A-5 have been filled out with hypothetical data to aid in understanding the scoring procedure.

Scoring: Modification Variable--The first step in the scoring procedure was to convert all ordinal values (the 1 to 5 scales in Figures A-4 and A-5) to 0-1 dichotomies; values of 3 or greater being converted to 1's and values of 1 or 2 being converted to 0's. The numbers in parentheses in Figures A-4 and A-5 show the dichotomized versions of the example ordinal scores.

Dichotomized scores in the matrix shown in Figure A-4 were then summed for each of the factors listed on the left side of the matrix. The "motivation score" was then computed as the sum of the dichotomized scores for the three environmental factors (denoted by asterisks on the left side of Figure A-4) divided by the sum of dichotomized scores for all factors.

FIGURE A-5

ALLEVIATION OF ADVERSE ENVIRONMENTAL EFFECTS

Please indicate the degree to which the proposed project, as presently envisioned, alleviates the adverse environmental effects listed.

Adverse Environmental Effects of Authorized Plan	No Change	Slightly Alleviated	Moderately Alleviated	Largely Alleviated	Completely Avoided	Dichotomized Score
Loss of wildlife habitat	1	2	3	[✓ 4]	5	1
Dust during construction	1	[✓ 2]	3	4	5	NA
Loss of Spawning area	1	[✓ 2]	3	4	5	0
	1	2	3	4	5	
	1	2	3	4	5	
	1	2	3	4	5	
	1	2	3	4	5	
	1	2	3	4	5	

$$\text{"Alleviation Score"} = \frac{\Sigma \text{ of dichotomized score for long term effects}}{\# \text{ of long term effects}} = \frac{1}{2} = 0.50$$

MODIFICATION SCORE:

	"Motiviation Score"	0.10
+	"Alleviation Score"	+ 0.50
	Subtotal	0.60
+	0 if no PACR/no major environmental modification 1 if PACR/major environmental modification	+ 0.00
	MODIFICATION SCORE	0.60

Adverse effects listed on the form shown in Figure A-5 were then classified by the researcher as "short term" or "long term" and the "short term effects" deleted from the form.* The "alleviation score" was then computed as the sum of all the dichotomized scores for "long term" adverse effects divided by the total number of "long term" adverse effects listed.

The next step in scoring the modification variable was the division of the planning studies sampled into two groups. One group consisted of those studies for which a Post Authorization Change Report (PACR) was required and in which the modifications indicated by the study manager as having been motivated by environmental factors (i.e., those factors noted by asterisks in Figure A-4) were also described in the PACR as being significant post-authorization changes in response to environmental considerations. The other group consisted of studies where a PACR was not required or where the required PACR described modification unrelated to environmental considerations.** For the studies in the first group thus defined, a "bonus point" was then added to the sum of the "motivation score" and "alleviation score" to ensure that studies having major modifications in response to environmental considerations would attain a higher rank in terms of the modification variable scores than studies having no such modifications. This completes the scoring procedure for the modification variable.

A.2 INDEPENDENT VARIABLES: ORGANIZATION

Four characteristics of the organizational structure and internal processes of planning activity carried out in Corps District offices were studied in this investigation. These included: 1) Formal Organizational Design, 2) Communication, 3) Conflict Resolution, and 4) Role Perceptions.

---

*This served to eliminate relatively minor adverse effects, such as noise or dust from construction, from consideration leaving only more substantial effects, such as losses of habitat or community dislocations.

**This procedure served effectively to isolate those studies where major modifications were made in response to environmental considerations (i.e., the first group).

In the following sections, a relationship between each organizational characteristic and each of the dependent variables previously defined is hypothesized. Each organizational characteristic is then defined according to the series of variables by which it is measured. Finally, indices representing the extent to which the various organizational characteristics were present in planning studies are defined.

Formal Organizational Design

Hypothesis--The influence of environmental information on the formulation and ranking of alternatives, and on the modification of a proposed plan, will be increased if the formal organizational design lends greater authority to the environmental specialist.

Conceptual Definition: Formal Organization Design Variables--Formal organizational design consists of those codified structures or procedures governing the operation of a Corps District office. These structures or procedures lend authority to the environmental specialist by defining his position in the organizational hierarchy and by assigning him certain responsibilities. The extent of the environmental specialists' authority was measured by the following variables:

-- The relative positions and sizes, as reflected in organizational charts, of the Planning unit and the Environmental Resources unit;

-- the existence of written mandates for the environmental specialist to participate in more broadly defined planning tasks;

-- the relative GS levels of the study manager and environmental specialist.

Operational Definition: Formal Organization Design Variables--The relative positions of the Planning unit and the Environmental Resources (ER) unit in each District were ascertained from organization charts included in the Statement of Functions for each District. The sizes, in terms of professional personnel, of the Planning unit for each study were ascertained by asking the study manager and Planning unit chief the following question:

Q1. "How many people, excluding clerical staff, have been employed in the planning (branch) while this study has been underway?"

The size of the ER unit was ascertained by asking the environmental specialist and ER unit chief the following question:

> Q2. "During the course of this study, how many people have been employed in the environmental (section), excluding clerical staff?"

The existence of written mandates for environmental specialists to participate in broadly defined planning tasks was determined by examining the formal duties of environmental specialists, set out in the Statement of Functions of each District, for the presence of the following six tasks: 1) problem definition, 2) determining study objectives, 3) alternative formulation, 4) impact assessment, 5) alternative evaluation or ranking, and 6) external coordination. In addition, where these tasks were mandated, the wording of the tasks was analyzed to determine if the task was specifically limited to environmental quality matters. For example, did the formal mandate for participation of environmental specialists in the formulation of alternatives limit that role to the formulation of Environmental Quality (EQ) plans.

The GS levels of study managers and environmental specialists were obtained simply by asking each what his GS rating had been during the planning study.

Scoring: Formal Organizational Design Variables--The relative positions of the Planning and ER units in the organization hierarchy were scored as follows: If the ER unit was a Section within a Planning Branch a score of '0' was assigned. If the ER unit had Branch status either equal to the Planning Branch or within a Planning Division, a score of '1' was assigned.

The relative sizes of the ER and Planning units were expressed as a size ratio using the responses from Q1 and Q2 above.

$$\text{size ratio} = \frac{\text{\# of professionals in ER unit}}{\text{\# of professionals in Planning unit}}$$

The written mandates describing the formal duties of environmental specialists were scored as follows:

i) where the specific task was not mandated a '0' was assigned.

ii) where the specific task was mandated but limited to EQ matters a '1' was assigned.

iii) where the specific task was mandated in general terms a '2' was assigned.

An overall breadth of role index was computed as the sum of the scores assigned to each of the six tasks using the procedure described above.

The relative GS ratings of environmental specialists and study managers were expressed as a ratio:

$$\text{GS ratio} = \frac{\text{GS rating of environmental specialist}}{\text{GS rating of study manager}}$$

No attempt was made to further aggregate the variables described above.

Communication Behavior

Hypothesis--The influence of environmental information on the formulation and ranking of alternative plans, and on the modification of a proposed plan, will be increased if the communication behavior of the study manager and the environmental specialist encourages the transfer of information between the two.

Conceptual Definition: Communication Variables--In this context "communication behavior" refers to the practices and procedures typically used to transfer information. Communication behavior encourages the transfer of information to the extent that it is open, informal and direct. These characteristics of the communication behavior between the study manager and the environmental specialist were measured by means of the following variables:

-- The extent to which informal mechanisms of communication (i.e., coordination with groups, informal interaction between planners and environmental specialists) is utilized more frequently than formal mechanisms of communication (i.e., existing documents, interoffice memoranda, coordination through superiors);

-- the frequency of both verbal and written communication between the study manager and the environmental specialist;

-- the frequency with which the study manager requests feedback from the environmental specialist;

-- the frequency with which the environmental specialist provides feedback to the study manager whether or not it is requested;

- -- the proportion of communication between the study manager and the environmental specialist whose message function is innovation-oriented rather than task-oriented;
- -- the frequency with which the environmental specialist initiates communication with the study manager.
- -- whether or not formal interdisciplinary teams were used in the study.

Operational Definition: Communication Variables--The relative use of formal and informal communication mechanisms was ascertained by asking both the study manager and the environmental specialist the following question:

> Q3. "This table lists various communication and coordination mechanisms typically used to transfer information between individuals in large organizations. Using the scale provided, would you indicate the relative amount of use each has had in this study regarding communication between the environmental specialist/study manager and yourself?"

	Amount of Use				
Mechanism	Little or None	Some	Quite a Lot	Used Almost Always	Used Exclusively
1. You rely on existing reports and documents of others.	1	2	3	4	5
2. You use standard forms or office memos.	1	2	3	4	5
3. Superiors take care of information transfer and coordination.	1	2	3	4	5
4. Project teams or task forces are established for coordination purposes.	1	2	3	4	5
5. You rely on informal relationships and interaction.	1	2	3	4	5

The other communications attributes were measured by asking both study managers and environmental specialists the following series of questions:

Q4. "In the course of the study about how often, on the average, have you communicated verbally with the environmental specialist/study manager about the study?"

a) once a month or less
b) two or three times a month
c) about once a week
d) several times a week
e) at least once a day

Q5. "About how often, on the average, have you communicated with him in writing?"

a) once a month or less
b) two or three times a month
c) about once a week
d) several times a week
e) at least once a day

Q6. "When you (he) makes a request of or assign(s) a task to the environmental specialist (you), how often do you (does he) specifically ask for feedback?"

a) less than 20% of the time
b) 20 - 40% of the time
c) 40 - 60% of the time
d) 60-80% of the time
e) more than 80% of the time

Q7. "Of all the communication you have had with the environmental specialist/study manager on this study, how much was related to innovation, i.e., new ideas or ways of doing things, rather than related to a specific task?"

a) less than 20%
b) 20 - 40%
c) 40 - 60%
d) 60 - 80%
e) more than 80%

Q8. "Of all the communication between the environmental specialist/study manager and yourself, how much was initiated by him rather than a response to a request?"

a) less than 20%
b) 20 - 40%
c) 40 - 60%
d) 60 - 80%
e) more than 80%

In addition, the following question was asked of the environmental specialist:

Q9. "About what percentage of the time do you provide feedback anyway?" (regardless of whether it was requested)

a) less than 20% of the time
b) 20 - 40% of the time
c) 40 - 60% of the time
d) 60 - 80% of the time
e) more than 80% of the time

The extent to which formal interdisciplinary teams were used in the study is determined by asking both the study manager and environmental specialist the following series of questions:

Q10. "Was an interdisciplinary planning team formally organized to conduct this study?"

IF YES, SKIP NEXT QUESTION

Q11. "Did an interdisciplinary team develop informally?"

Q12. "Who were the main participants in this team?"

Q13. "How many times since the study was begun has this team met as a group?"

Although not scored and used in the statistical analysis, the following questions were addressed to both respondents as a means of gaining additional insights into the coordination between study managers and environmental specialists.

Q14. "Do you believe that the coordination between planners and environmental specialists on this study was adequate or could it have been more effective?"

Q15. "What was the greatest barrier to this effective coordination?"

Scoring: Communication Variables--The scores for responses to question Q3 were simply the ordinal values indicated by study managers and environmental specialists. In addition, an index reflecting greater reliance on informal communications mechanisms was constructed as follows: first, all responses given by both study managers and environmental specialists were converted from ordinal values to 0-1 dichotomies using a cutpoint of 3 (i.e., values of 1 and 2 become 0's and values of 3 through 5 become 1's), then the sum of the dichotomized scores of both respondents to items 1, 2, and 3 of Q3 were added together and this sum subtracted from the sum of the dichotomized scores of both respondents to items 4 and 5 of Q3. Lastly, a constant of 6 was added to the result to ensure that the index did not assume negative values. The resulting index of communication informality thus ranges in score from 0 to 10, a 0 indicating complete reliance on the formal mechanisms denoted by items 1, 2, and 3, and a 10 denoting complete reliance on the informal mechanisms denoted by items 4 and 5.

Scores were assigned to responses of both respondents to questions Q4 through Q8 according to the following scheme: a = +1, b = +2, c = +3, d = +4 and e = +5. In addition, an index of interactive communication was constructed using the responses of both respondents to questions Q4, Q6, and Q7 and the response of the environmental specialist to question Q8. To construct this index the ordinal values for these responses were converted to 0-1 dichotomies using a cutpoint of 3 (i.e., values of 1 and 2 became 0's and values of 3 through 5 became 1's) and summed. The resulting index ranges in value from 0 to 7, a 0 reflecting no interactive communication and a 7 reflecting highly interactive communication.

The responses to questions Q10 through Q13 regarding interdisciplinary teams were used simply to determine whether or not formal interdisciplinary teams were used in the study. If both respondents replied in the affirmative to either question Q10 or Q11 and if an environmental specialist was described as being a "main participant" on the team (Q12) and if the team met at least once as a group during the study (Q13) a score of '1' was assigned, otherwise a score of '0' was assigned.

Perceived Role

Hypothesis--The influence of environmental information on the formulation and ranking of alternative plans, and on the modification of a proposed plan, will be increased if the study manager perceives the duties of the Environmental Resources unit to include the broader activities of formulation and evaluation rather than specific, narrowly defined tasks.

Conceptual Definition: Perceived Role Variables--The perceived duties of the Environmental Resources (ER) unit are what the study manager thinks the main functions of the unit are in the context of a particular study. This perception may largely determine what he requests and expects of the ER unit and the environmental specialist. The extent to which these duties are broadly perceived is reflected in the extent to which they include planning activities such as problem definition, study objective identification, formulation and evaluation of alternatives, impact assessment and external coordination.

Operational Definition: Perceived Role Variable--The following questions were asked of the study manager* to ascertain his views of the function served by the ER unit in the planning study.

Q16. "In retrospect, what would you regard as having been the primary function of the environmental (unit) on this study?"

Q17. "Could you describe, in a few words, what you would regard as having been the next three most important functions of the environmental (unit)?"

PROBE FOR RESTRICTIONS TO EQ OR GENERAL

Scoring Perceived Role Variables--The responses to questions Q16 and Q17 were analyzed for content of the following six tasks: 1) problem definition, 2) determination of study objectives, 3) formulation of alternatives, 4) impact assessment, 5) alternative evaluation or ranking, and 6) external coordination (with agencies and publics). The following scores were then assigned for each task:

'0' if the task was not mentioned

'1' if the task was mentioned but limited to environmental quality matters (e.g., formulation of an EQ plan)

'2' if the task was mentioned and non-EQ applications were referred to

An overall index of role perception was taken as the sum of scores thus assigned for each of the six tasks.

Conflict Resolution

Hypothesis--The influence of environmental information on the formulation and ranking of alternative plans, and on the modification of a proposed plan, will be increased if the role of the environmental specialist in the resolution of conflict is increased.

Conceptual Definition: Conflict Resolution Variables--In this context conflict is taken to mean opposing (not necessarily diametrically opposite) values, views or judgments on the part of the study manager and the environmental specialist regarding choices between various strategies, alternatives or policies affecting the course of the planning study. The increased role of the environmental specialist in the resolution of such conflicts is reflected in the extent to which such conflicts are confronted openly and discussed frankly (e.g., a confrontation mode) and the extent to which compromise results. A decreased role of the environmental specialist in conflict resolution is reflected in; 1) resolution by the dominance of the study managers point of view (e.g., a forcing mode), 2) conscious avoidance of conflict (e.g., a withdrawal mode), and 3) glossing over of conflict (e.g., a smoothing mode).

---

*Although not a part of the a priori hypothesis the role perceptions of environmental specialists were also ascertained in the field interviews in a manner identical to that described here for study managers.

Operational Definition: Conflict Resolution Variables--Both study managers and environmental specialists were asked the following question:

> Q18. "In the course of a planning study, disagreements and differences of opinion continually arise between the various participants in the study. Try to recall the times when such differences of opinion, however small, have arisen between yourself and the environmental specialist (study manager). This table (HAND RESPONDENT FORM) lists a number of proverbs or sayings which may describe the way in which differences between people are resolved. Using this scale provided, would you indicate the extent to which each proverb reflects the way in which diferences between the environmental specialist (study manager) and yourself have been resolved."

	Extent of Occurrence				
Proverbs and Sayings	Rarely or Never		Some-times		Very Frequent
1. The arguments of the strongest always have the most weight.	1	2	3	4	5
2. It is easier to refrain from a quarrel than to retreat from one.	1	2	3	4	5
3. Smooth words make smooth ways.	1	2	3	4	5
4. You scratch my back; I'll scratch yours.	1	2	3	4	5
5. Come now and let us reason together.	1	2	3	4	5
6. When one hits you with a stone, hit him with a piece of cotton.	1	2	3	4	5

	Extent of Occurrence				
Proverbs and Sayings	Rarely or Never		Sometimes		Very Frequent
7. By digging and digging the truth is discovered.	1	2	3	4	5
8. Might overcomes right.	1	2	3	4	5
9. He loses least in a quarrel who keeps his tongue in his cheek.	1	2	3	4	5
10. Better half a loaf than no bread.	1	2	3	4	5
11. Seek 'til you find and you'll not lose your labor.	1	2	3	4	5
12. If you cannot make a man think as you do, make him do as you think.	1	2	3	4	5
13. Tit for tat is fair play.	1	2	3	4	5
14. Kill your enemies with kindness.	1	2	3	4	5

Scoring: Conflict Resolution Variable--Scores for individual proverbs were simply those values indicated by the responses to question Q16. Proverbs reflecting each of the five modes of conflict resolution are:

confrontation - proverbs 5, 7, and 11
compromise - proverbs 4, 10, and 13
smoothing - proverbs 3, 6, and 15
withdrawal - proverbs 2, 9, and 14
forcing - proverbs 1, 8, and 12

Ordinal values for each proverb were then converted to 0-1 dichotomies; values of 1 and 2 becoming 0's and values of 3 or greater becoming 1's. The dichotomized scores of each respondent for the proverbs reflecting each of the five modes of conflict resolution were then summed to obtain *indices of the extent of occurrence of each mode of conflict resolution*. This yielded five indices for each respondent (study manager and environmental specialist), one index ranging in value from 0 to 3 for each of the five modes. Overall indices for each of the five modes were obtained by adding the indices of the two respondents for each mode. This produced five indices ranging in value from 0 to 6, each describing the extent of use of one of the five modes of conflict resolution.

A.3 INDEPENDENT VARIABLES: ATTITUDES AND VALUES

Hypothesis--The influence of environmental information on the formulation and ranking of alternative plans, and on the modification of a proposed plan, will increase if the study manager has a more positive attitude regarding the significance of environmental factors in planning.

Conceptual Definition: Attitude Variables--The assumption underlying the use of this variable is that behavior is significantly affected by attitude. The extent to which the attitude of the study manager is more positive regarding the significance of environmental factors is exhibited by:

- The extent to which the study manager is willing to forego other project benefits in favor of environmental quality goals.
- The extent to which the study manager views activities which show more concern for incorporating environmental factors in planning as good things to do and, conversely, activities which show less concern as bad things to do.

Operational Definition: Attitudes and Values--The degree of willingness of the study manager to forego other project benefits in favor of environmental quality goals is measured using Guttman scaling. Guttman scales were developed from the responses to the following questions, addressed to the study manager"

Q1. "Now I'd like you to take a few minutes to respond to a series of statements of opinion about the planning of public works projects in general. These statements are not meant to apply to this study in particular but to apply to planning in a general sense. Please read each statement of opinion on this form (HAND FORM) and then circle the extent of your agreement or disagreement with each."

Strongly Disagree (SD)	Disagree (D)	Neutral (N)	Agree (A)	Strongly Agree(SA)
-2	-1	0	+1	+2

		SD	D	N	A	SA
1.	Measures designed to protect or enhance the environment should usually be included in project proposals as long as the resulting project benefits aren't less than the costs.	-2	-1	0	+1	+2
2.	Moderate decreases in regional economic development are acceptable in return for the preservation of natural areas.	-2	-1	0	+1	+2
3.	The expense required for environmental enhancement measures needs to be justified by equivalent environmental benefits.	-2	-1	0	+1	+2
4.	It would rarely be reasonable for environmental factors rather than economic considerations to control project design.	-2	-1	0	+1	+2
5.	The 'no action' alternative would be justified in order to provide environmental protection.	-2	-1	0	+1	+2
6.	It is possible for the unquantifiable or intangible benefits of environmental protection measures to be great enough to justify a project which has an economic benefit cost ratio of less than 1.	-2	-1	0	+1	+2
7.	Although economics may be more important, we should expect some environmental protection features to be included in nearly every plan recommendation.	-2	-1	0	+1	+2
8.	Environmental considerations should not be allowed to dictate significant reductions in other project benefits.	-2	-1	0	+1	+2
9.	Environmental enhancement features should be included in public projects if they favorably affect project economic evaluation.	-2	-1	0	+1	+2
10.	Environmental protection measures should be included in project proposals regardless of their effects on calculated benefits and costs.	-2	-1	0	+1	+2
11.	It would be unacceptable to base a decision to do nothing mostly on a desire to preserve natural areas.	-2	-1	0	+1	+2

		SD	D	N	A	SA
12.	The overall benefits which result from environmental enhancement measures rarely justify the expense which is required for implementation.	-2	-1	0	+1	+2
13.	Good public works planning gives equal weight to both environmental and economic considerations.	-2	-1	0	+1	+2
14.	Preservation measures should often be included in public projects even if they don't improve the overall benefit-cost ratio.	-2	-1	0	+1	+2
15.	Environmental protection measures should be included in public projects if the resulting economic benefit cost ratios for the projects remain greater than one.	-2	-1	0	+1	+2
16.	We should usually include preservation measures in plan recommendations if they have no detrimental effects on local economic development.	-2	-1	0	+1	+2
17.	Increased unemployment in the study area is justified by a desire for environmental protection.	-2	-1	0	+1	+2
18.	The benefits of environmental enhancement measures are sometimes outweighed by the expenses which are associated with them.	-2	-1	0	+1	+2
19.	It would be unacceptable to allow great reductions in the economic growth of the study region in order to avoid project-related environmental degradation.	-2	-1	0	+1	+2
20.	If an environmental enhancement measure requires no tradeoff of other project benefits, it should be included in the plan recommendation.	-2	-1	0	+1	+2
21.	Environmental preservation measures could be justified even if it meant putting a stop to future economic growth in the region.	-2	-1	0	+1	+2
22.	The inclusion of environmental protection measures can justify some reduction in the economic benefit cost ratio of a proposed project.	-2	-1	0	+1	+2
23.	Unless the resulting project benefits at least equal the costs, environmental protection measures should be left out of project proposals.	-2	-1	0	+1	+2
24.	Environmental enhancement should be excluded from project proposals if it would result in any constraints on regional economic growth.	-2	-1	0	+1	+2

From the responses to these opinion statements, well defined procedures (see, e.g., Nie, et al., 1975) are used to identify sets of items which comprise scales.* This process resulted in the identification of the following three scales (the numbers in parentheses are the corresponding item numbers from question Q1 above):

SCALE A

1. Preservation measures should often be included in public projects even if they don't improve the overall benefit-cost ratio. (14)
2. Environmental considerations should be allowed to dictate significant reductions in other project benefits. (8)
3. The expense required for environmental enhancement measures does not need to be justified by equivalent environmental benefits. (3, reversed).

SCALE B

1. Environmental enhancement should not be excluded from project proposals because of constraints on regional economic growth. (24, reversed)
2. Moderate decreases in regional economic development are acceptable in return for the preservation of natural areas. (2)
3. It would be acceptable to allow great reductions in the economic growth of the study region in order to avoid project-related environmental degradation. (19, reversed)
4. Increased unemployment in the study area is justified by a desire to preserve the environment. (17)

SCALE C

1. The overall benefits which result from environmental enhancement measures often justify the expense which is required for implementation. (12, reversed)
2. Moderate decreases in regional economic development are acceptable in return for the preservation of natural areas. (2)
3. Environmental considerations should be allowed to dictate significant reductions in other project benefits. (8, reversed)

---

*Responses from the CALTRANS and Bureau of Reclamation portions of the research reported herein were pooled with those obtained from the Corps interviews for this scale development exercise.

4. Environmental preservation measures could be justified even if it meant putting a stop to future economic growth in the region. (21)
5. The expense required for environmental enhancement measures does not need to be justified by equivalent environmental benefits. (3, reversed)

The activities which study managers perceived to be "good things" and "bad things" to do were ascertained using a value assessment technique known as ECHO, which consisted of asking the following questions:*

Q2. "What would be the best thing that you could do or could have done in this investigation for which you might receive praise?"

Q3. "Who would be the source of praise?"

Q4. "What would be the worst thing that you could do or could have done in this investigation for which you might be criticized?"

Q5. "Who would be the source of that criticism?"

These questions were each repeated substituting "another good thing" for "best thing" and "another bad thing" for "worst thing" until five "good thing" responses and five "bad thing" responses were obtained or no further responses could be provided.

Scoring: Attitude Variables--For each opinion statement in the Guttman attitude scales strong agreement and agreement were scored as a '1' and neutrality, disagreement, or strong disagreement scored as a '0'. A score for each of the three scales (A, B, and C) was then computed as the sum of these 0-1 scores for the statements comprising the scale. Thus three measures of study manager attitudes were obtained, ranging in value from 0 to 3, 0 to 4, and 0 to 5 for scales A, B, and C, respectively, higher scores indicating a greater willingness to forego other project benefits in favor of environmental quality goals.

The scoring of the ECHO value assessment responses was more complex, involving first the classification exercise described below. Individual responses to the "good thing" and "bad thing" questions were each written on a '3 x 5' card. Members of the research team then independently classified all responses to the "good thing" questions into groups having similar meanings. The same classification was done for the "bad thing" responses. These independent classifications were recorded and, along with a fifth round of classification conducted by the research team working together, used to define a consensus preliminary set of categories comprised of ECHO responses having like meanings. Typed lists of the "good thing" and "bad thing" responses, presented in these preliminary groupings, were then mailed to the study managers ("good thing" lists to half and "bad thing" lists to half), who had participated in the field interviews, for further classification and scoring. Along with each list was sent the following instructions:

---

*Although not a part of the a priori hypothesis, these questions were also addressed to environmental specialists. The scoring procedure used was identical to that described below for study managers except that the environmental specialists acted as judges in the classification and scoring of their responses.

"The attached sheets contain groups of statements obtained in a recent interview survey of Corps of Engineers planners conducted by researchers at the Civil Engineering Department at Stanford University. Each statement is a response to the question:

> "What would be the best thing you did or might have done in this planning study for which you might receive praise or approval?"*

The groupings are an attempt by the research staff to lump together statements (responses) meaning essentially the same thing. The research study now needs your help to act as a judge in refining these groupings and in assigning scores to each group and any individual statements which defy grouping.

As the first part of the judging exercise, we would like you to read through the statements in each group and note any you feel do not belong in the group. For each statement so noted, please indicate the letter of the group to which you feel the statement should belong. If you feel new groups are necessary, please use roman numerals to indicate these. (This will make it easier for us to process the data). Also, please read through the list of unclassified statements to see if you feel any of them should be assigned to other groups.

---

*The instructions accompanying the "bad thing" responses referred to "worst" and "criticism" rather than "best" and "praise/approval".

Once you feel satisfied with the arrangement of statements and groups, you are ready to begin the second part of the judging exercise. To do this ask yourself, for each group of statements, and for each unclassified statement, the following question:

> "How much do these statements reflect concern for incorporating environmental considerations in planning decisions?"

Then assign a score from the following scale which you feel best describes the level of concern exhibited by the statements.

1 = exhibits little or no concern for incorporating environmental factors
2 = exhibits some concern for incorporating environmental factors
3 = exhibits a fair amount of concern for incorporating environmental factors
4 = exhibits quite a lot of concern for incorporating environmental factors
5 = exhibits very much concern for incorporating environmental factors

To help you get started, we suggest you first assign a 1 to the group you feel exhibits least concern and a 5 to the group exhibiting most concern. These may then serve as reference points for later decisions. Please use the following lists of factors as a guide for deciding what is "environmental" and what is not:"

Environmental Factors	Non-Environmental Factors
ecology	economics/finance
fish/wildlife habitat	technical design
historical/archeological	geology/foundations
air/water quality	acceptability to sponsor
community cohesion/SWB	acceptability to hierarchy
aesthetics	acceptability to agencies
land use/open space	traditional missions
outdoor recreation	use of project outputs

This procedure resulted in each ECHO response being assigned a numerical score by 12 study managers. The median of these scores was then adopted as the final score for each response. Thus each ECHO response takes on a value between 1 and 5, higher scores indicating a greater concern for incorporating environmental factors in planning.

A.4 INDEPENDENT VARIABLES: EXTERNAL COORDINATION

Four characteristics of the Corps practices and procedures regarding the involvement of other agencies, interest groups and individual citizens in project planning were studied in this investigation. These included: 1) Commitment to Obtaining Input, 2) Generation of New Information, 3) Perception of Pressure, and 4) Responsiveness to External Input.

Commitment to Obtaining Input

Hypothesis--The influence of environmental information on the formulation and ranking of alternative plans, and on the modification of a proposed plan, will be increased if the project planners exhibit a greater commitment to obtaining external input.

Conceptual Definition: Commitment Variables--External input here refers to information relevant to project planning received from other agencies, interest groups and individual citizens. Commitment to obtaining this input was measured by the following variables:

- -- the extent of involvement of environmentally oriented agencies in the study
- -- the extent of involvement of environmentally oriented interest groups in the study
- -- the extent of public involvement occurring in the study
- -- the extent to which documents describing environmental effects of proposals were distributed outside the Corps before the draft EIS
- -- the extent to which those documents presented a range of alternatives and were prepared in a readable form.

Operational Definition: Commitment Variables--The involvement of other agencies and interest groups in each planning study was determined by asking the study manager the following series of questions:*

> "The next series of questions deals with the involvement of other agencies, groups and public in the (name of study) study. For the purposes of answering these questions let's define "close coordination" as the frequent and meaningful exchange of information, to be distinguished from required or relatively routine notifications of progress."

---

*The environmental specialist was asked a similar series of questions which were not analyzed except to provide validation for responses given by study managers.

Q1. "With which federal, state, or local agencies have you maintained close coordination during this study?"

Q2. "With which non-governmental interest groups have you maintained close coordination during this study?"

The agencies and interest groups thus described were later classified by the researcher as "environmental" or "non-environmental" based on their roles and missions in each study. In addition,the following questions, which do not reflect this classification, were asked of the study manager:

Q3. "On the average, how would you characterize the frequency of meaningful contact with these agencies since the study was initiated?"

a) less than once a year
b) one to four times a year
c) five to eight times a year
d) nine to twelve times a year
e) more than once a month

Q4. "On the average, how would you characterize the frequency of meaningful contact with these groups since the study was initiated?"

a) less than once a year
b) one to four times a year
c) five to eight times a year
d) nine to twelve times a year
e) more than once a month

The extent of public involvement in the study was ascertained using the following questions asked of the study manager:

Q5. "What formal public meetings or hearings have been arranged by this office so far in the study?"

Q6. "Have any citizens committees been formed with the cooperation of this office to assist liaison with local publics?"

Q7. "Have any other public participation programs been initiated by this office on this study?"

Q8. "Which of the following statements best characterizes the frequency of all public meetings arranged by this office since the study was initiated?"

a) less than once a year
b) one to four times a year
c) five to eight times a year
d) nine to twelve times a year
e) more than once a month

The extent to which pre-draft EIS environmental documentation had been prepared and circulated outside the Corps was ascertained by asking the following question of study managers:

> Q9. "What documents, reports or papers other than office memos (df's) describing the environmental effects of alternatives or plans have been prepared so far in the study?"
>
> OBTAIN COPY OF EACH FOR ANALYSIS

Copies of these documents and mailing lists used in their distribution were then obtained and analyzed for the following:

1) Format - documents were classified as either brochures or reports.
2) Readability - readability was determined using the Fog Index based on the first two complete sentences of three pages chosen at random.
3) Range of Alternatives - documents were examined to see if emphasis was on a proposed plan or a range of alternatives, and the number of alternatives discussed was counted.
4) Distribution - mailing lists for each document were used to ascertain the following:
    i) the number of agencies receiving copies
    ii) the number of non-governmental interest groups receiving copies
    iii) the number of unaffiliated individuals receiving copies.

Although not scored and used as a part of the statistical analysis, the following questions were asked of study managers to provide additional insights into the process used in obtaining external input:

> Q10. "Do you feel that the coordination on this study with outside agencies was adequate or could it have been more effective?"
>
> Q11. "What was the greatest barrier to this effective coordination?"
>
> Q12. "Do you feel that the coordination with interest groups and the public on this study was adequate or could it have been more effective?"
>
> Q13. "What was the greatest barrier to this effective coordination?"

Scoring: Commitment Variables--Responses to questions Q1 and Q2 were used to establish the number of environmentally oriented agencies and the number of environmentally oriented interest groups closely involved in each study. In addition the number of planning workshops or seminars held with other agencies and interest groups were determined from unstructured questioning regarding the roles of those agencies and groups.

Finally the frequencies of contact with other agencies and interest groups, ascertained in questions Q3 and Q4, were assigned numerical values in the following manner: a = +1, b = +2, c = +3, d = +4, e = +5.

The scores described above were aggregated into two indices reflecting agency and interest group involvement as shown below:

  # of environmental agencies (groups) involved
+ # of workshops or seminars with agencies (groups)
+ 1 if frequency of contact with agencies (groups
___ equals or exceeds a value of 3.
= index score

Question Q5 was used to establish the number of formal public meetings or hearings held during the study. In addition, the number of public workshops or seminars held and the number of informational presentations conducted were established through probing of responses to question Q7. In addition, the frequency of contact between planners and the public described in Q8 was converted to an ordinal numeric value in the following manner; a = +1, b = +2, c = +3, d = +4, e = +5.

An overall index of public involvement was defined as shown below:

  # of formal public meetings or hearings
+ # of public workshops or seminars
+ # of informational presentations
+ 1 for frequencies of public contact
___ equal to or exceeding a value of 3.
= index score

Two additional indices were also defined. A workshop index was defined as the sum of all agency, interest group, and public workshops and seminars held during the study. An interactive involvement index, reflecting the extent to which measures beyond those required by regulations were employed during the planning study to obtain external input from publics, was defined as shown below:

  # of interest group and public workshops
+ # of other informational presentations
+ 1 for frequencies of group contact ≥ 3
+ 1 for frequencies of public contact ≥ 3
= index score

With regard to documentation, the analysis of documents obtained in response to question Q9 established the number of pre-draft EIS environmental documents prepared during the study. Only documents which discussed environmental effects of a plan or plans and which were completed prior to the draft EIS were counted in this number. The analyses of the mailing lists of such documents were used to obtain counts of the number of agencies receiving copies, the number of non-governmental interest groups receiving copies and the number of unaffiliated individuals receiving copies. For each document, these three counts were coded as ordinal values according to the following schemes:*

# Receiving Copies	Assigned Value
5 or fewer agencies	+1
6-15 agencies	+2
16-30 agencies	+3
31-50 agencies	+4
51 or more agencies	+5
no interest groups	+1
1-10 groups	+2
11-20 groups	+3
21-30 groups	+4
31 or more groups	+5
10 or fewer individuals	+1
11-25 individuals	+2
26-50 individuals	+3
51-100 individuals	+4
more than 100 individuals	+5

Indices of distribution of documents for each study were obtained by converting the ordinal values assigned above to 0-1 dichotomies, based on a cutpoint of 3 (i.e., values of 1 and 2 become 0's and values of 3 or more become 1's), and adding the dichotomized scores for all pre-draft EIS documents prepared in the study. This resulted in three indices, one each describing overall agency distribution, overall interest group distribution, and overall individual distribution of pre-draft EIS environmental documents. In addition, an index of total distribution was defined as the sum of the three distribution indices for agencies, interest groups and individuals.

---

*The categories used in each scheme were defined, after the overall distributions of documents for all studies was known, to facilitate data coding and analysis.

Readability of documents, measured by the Fog Index, was computed as follows based on the first two complete sentences on three pages chosen at random from each document:

Fog Index = 0.4 (average # of words per sentence + percentage of words having 3 or more syllables)

The focus of each document was defined as '0' if the document emphasized a selected or proposed plan and a '1' if the document discussed alternatives without emphasis on any one. In addition, the number of alternatives discussed in each document was established and coded.

Generation of New Information

Hypothesis--The influence of environmental information on the formulation and ranking of alternative plans, and on the modification of a proposed plan, will be increased if new information is generated by coordination with outside agencies, interest groups and individual citizens.

Conceptual Definition: Generation of New Information Variables--The information generated by coordination refers to comments, suggestions and criticism received from agencies, groups and individuals in the course of hearings, meetings, communications and review of planning documents. The extent to which such information is new was measured by the following variables:

-- The extent to which the information represents new knowledge
-- The extent to which the information is specific
-- The extent to which the information is constructive.

Operational Definition: New Information Variables--The extent to which the comments of other agencies, interest groups and the public represented new knowledge was determined by asking the study manager the following question:

Q14. "These tables (HAND FORM) list topic areas which are sometimes addressed by comments and suggestions from the agencies, groups, and citizens discussed. Using the scales provided would you indicate, for each source, the extent to which the comments and suggestions received represented new useful knowledge in each topic area."

COMMENTS FROM AGENCIES	Little or None	Small Amount	Fair Amount	Quite a Lot	Very Much
Problems and needs	1	2	3	4	5
Study objectives	1	2	3	4	5
Constraints on alternatives	1	2	3	4	5
New measures or features	1	2	3	4	5
New alternatives	1	2	3	4	5
Preferences for measures or features	1	2	3	4	5
Preferences for alternatives	1	2	3	4	5
Adverse effects or impacts	1	2	3	4	5
COMMENTS FROM INTEREST GROUPS					
Problems and needs	1	2	3	4	5
Study objectives	1	2	3	4	5
Constraints on alternatives	1	2	3	4	5
New measures or features	1	2	3	4	5
New alternatives	1	2	3	4	5
Preferences for measures or features	1	2	3	4	5
Preferences for alternatives	1	2	3	4	5
Adverse effects or impacts	1	2	3	4	5
COMMENTS FROM INDIVIDUALS					
Problems and needs	1	2	3	4	5
Study objectives	1	2	3	4	5
Constraints on alternatives	1	2	3	4	5
New measures or features	1	2	3	4	5
New alternatives	1	2	3	4	5
Preferences for measures or features	1	2	3	4	5
Preferences for alternatives	1	2	3	4	5
Adverse effects or impacts	1	2	3	4	5

The extent to which the comments and suggestions of agencies, interest groups, and citizens were viewed as specific and constructive were ascertained by asking the study manager the following two questions:

Q15. "How would you rate the comments and suggestions received from these agencies, groups, and citizens with respect to specificity?"

a) very vague
b) somewhat vague
c) neither vague or specific
d) somewhat specific
e) very specific

Agencies__________

Groups__________

Citizens__________

Q16. "How would you rate the criticism you have received from these agencies, groups, and citizens in terms of the extent to which it was constructive criticism?"

a) none was constructive
b) some was constructive
c) about half was constructive
d) most was constructive
e) all was constructive

Agencies________
Groups__________
Citizens________

Operational Definition: New Information Variables--The responses to question Q14 were coded simply as the numbers indicated by the respondent. Responses to questions Q15 and Q16 were transformed to numerical values in the following way; a = +1, b = +2, c = +3, d = +4, e = +5. An overall index of impact information was constructed based on responses to Q14 concerning new knowledge about constraints on alternatives and adverse effects or impacts gained from interest groups and citizens and on responses to Q15 concerning specificity of interest group and citizen comments. The coded scores for each of these six items were converted to 0-1 dichotomies, based on a cutpoint of 3 (i.e., values of 1 and 2 become 0's and values of 3 or higher become 1's), and the resulting dichotomized scores for the six items added together. The impact information index thus ranges from 0 to 6.

Level of Pressure

Hypothesis--The influence of environmental information on the formulation and ranking of alternative plans, and on the modification of a proposed plan, will be increased if the level of pressure from other agencies, interest groups and individuals on the District office doing the planning is increased.

Conceptual Definition: Level of Pressure Variables--Pressure is exerted on planners when the planners perceive that there is a larger amount of interest in the environmental aspects of the project than is usually the case. The level of various types of pressure perceived by planners in a planning study is measured by the following variables:

-- The amount of controversy surrounding the project

-- The level of local interest in the project

-- The level of pressure from Congressmen and administrative officials

-- The degree to which comments received from outside sources are critical

-- The extent of interagency coordination

-- The level of pressure from the Corps hierarchy

-- The threat of litigation

Operational Definition: Pressure Variables--The perceived level of pressure on planners due to factors other than litigation was determined by asking the study manager the following:

Q17. "Using the scale on this form (HAND FORM) would you indicate the extent to which each of the factors listed represents a departure from your experience or knowledge of similar investigations with regard to the environmental aspects of this study."

	Extent of Department from Norm				
Factor	Much Less Than Average	Less Than Average	About Average	More Than Average	Much More Than Average
1. Controversy surrounding the proposed project.	1	2	3	4	5
2. Level of local interest.	1	2	3	4	5
3. Criticism from local public.	1	2	3	4	5
4. Criticism from organized interest groups.	1	2	3	4	5
5. Extent of inter-agency coordination.	1	2	3	4	5
6. Criticism from other agencies.	1	2	3	4	5
7. Pressure from superiors in the Corps hierarchy.	1	2	3	4	5
8. Pressure from other high ranking administrative officials.	1	2	3	4	5
9. Congressional criticism.	1	2	3	4	5

The pressure on planners due to the threat of litigation was ascertained from unstructured questioning initiated by response to the following question asked of study managers:

Q18. "Do you believe that there is a significant threat of litigation on this project?"

IF YES, PROBE FOR ISSUES AND STATUS

Scoring: Pressure Variables--The responses to the individual items comprising question Q17 were scored by respondents using the ordinal scales provided. In addition, an index reflecting environmental concerns as a local issue was constructed based on items 1, 2, 3, 4, and 9 of question Q17. The responses given for these five items were converted to 0-1 dichotomies, based on a cutpoint of 4 (i.e., values of 1, 2, or 3 become 0's and values of 4 or 5 become 1's), and added.

Responses to question Q18 were coded as '1' if a significant threat of litigation over an environmental issue was perceived, and '0' otherwise.

Responsiveness to External Input

Hypothesis--The influence of environmental information on the formulation and ranking of alternative plans, and on the modification of a proposed plan, will be increased if the planners have a greater ability to be responsive to external input.

Conceptual Definition: Responsiveness to External Input Variables--Planners can be responsive to external input when they are unconstrained in their ability to act on and use information received from outside agencies, interest groups and individuals. The extent to which they feel constrained is measured by the following variables:

- The extent to which the suggestions received in external coordination are outside of the District's authority to plan and implement
- The extent to which the political climate of a project limits the planners' ability to act on external input
- The extent to which preferences of the Corps hierarchy limit the planners' ability to act on external input.
- The extent to which inadequate planning resources limit the planners ability to act on external input.

Operational Definition: Responsiveness Variables--The extent to which the factors above were perceived as constraints was ascertained by asking the study manager the following question:

> Q19. "Sometimes other factors inhibit your ability to be responsive to comments or suggestions received from agencies, groups, and individuals. This form (HAND FORM) lists several of these factors. Using the scale provided would you indicate the extent to which each of the factors inhibited your ability to respond to comments and suggestions from agencies, group, and citizens.

Factors Inhibiting Response	Extent of Constraint Severe	 Strong	 Moderate	 Slight	 None
1. Overall planning authority of the Corps of Engineers.	5	4	3	2	1
2. Amount of funding available.	5	4	3	2	1
3. Existence of treaties, plans, or compacts requiring compliance.	5	4	3	2	1
4. General political climate of project.	5	4	3	2	1
5. Preferences of District chiefs.	5	4	3	2	1
6. Non-satisfaction of problems and needs in area.	5	4	3	2	1
7. Lack of sufficient manpower.	5	4	3	2	1
8. Lack of expertise.	5	4	3	2	1
9. Scope of authorizing legislation.	5	4	3	2	1
10. Preferences of superiors at the Division level.	5	4	3	2	1
11. Preferences of superiors at OCE.	5	4	3	2	1

Scoring: Responsiveness Variables--The responses to individual items comprising question Q19 were simply encoded as the scores provided by the respondents. In addition two indices were defined, a hierarchy constraint index and a resource constraint index. The former aggregated responses to items 4, 5, 10, and 11 while the latter aggregated responses to items 2, 7, and 8. The ordinal values for these items were first converted to 0-1 dichotomies, based on a cutpoint of 3 (i.e., values of 1 or 2 became 0's and values of 3 or greater become 1's), and added. The hierarchy constraint index thus ranged from 0 to 4 while the resource constraint index ranged from 0 to 3.

A.5 INDEPENDENT VARIABLES: TIMING

The timing of two broad types of planning activity, namely, external coordination and environmental information development, were examined in this investigation. In both cases the extent of activity undertaken before two key dates was ascertained. These dates, which describe the point in time at which a consensus regarding the most desirable course of action was achieved and the point in time at which the agency first tentatively selected a proposed plan from a range of alternatives, are referred to as the Date of Office Consensus (DOC) and Date of Tentative Selection (DTS), respectively. All Timing variables for a study are defined in terms of the DOC and DTS.

Timing of Agency and Public Involvement

Hypothesis--The influence of environmental information on the formulation of alternative plans will be increased if there is increased involvement of other agencies, groups, and citizens before the study manager develops a preference for a specific alternative and before the agency tentatively selects a proposed plan.

Conceptual Definition: Timing of Agency and Public Involvement--The extent of involvement of agencies, groups, and citizens before the study manager develops a preference for a specific alternative and before the agency tentatively selects a proposed plan was measured by the following variables:

-- The number of environmental agencies contacted before the DOC and before the DTS

-- The number of environmental groups contacted before the DOC and before the DTS

-- The number of public meetings and workshops held before the DOC and before the DTS.

Operational Definition: Timing of Agency and Public Involvement--The DOC was ascertained by asking the study manager the following questions:

Q1. "It is quite probable, in an investigation such as this, that before a particular alternative plan is designated as the selected plan, there are other indications of which alternative is most desirable. These indications are based on formal analyses, opinions of other planners and specialists, informal discussions with local interests and one's own judgment, based on experience. Based on indications such as these, have you come to the conclusion that a particular alternative plan would be more desirable than the others?"

Q2. "Which alternative(s) is that?"

Q3. "When did you begin to feel that this alternative would be the most desirable?"

The DTS was ascertained by asking the study manager the following questions:

Q4. "Has an alternative plan tentatively been identified as the selected plan?"

Q5. "If so, which plan was that?"

Q6. "When was this tentative selection made?"

Data on the number of agencies and interest groups contacted during the study and on the number of public involvement activities held were available from questions asked of study managers to measure the Commitment to Obtaining Input variables (Section A.4). They are listed again below:

> "The next series of questions deals with the involvement of other agencies, groups and public in the (name of study) study. For the purposes of answering these questions let's define "close coordination" as the frequent and meaningful exchange of information, to be distinguished from required or relatively routine notifications of progress."

Q7. "With which federal, state, or local agencies have you maintained close coordination during this study?"

Q8. "When did the first substantive exchange occur with each?"

Q9. "With which non-governmental interest groups have you maintained close coordination during this study?"

Q10. "When did the first substantive exchange occur with each?"

Q11. "What formal public meetings or hearings have been arranged by this office so far in the study?"
PROBE FOR DATES.

Q12. "Have any agency or interest group task forces or citizens advisory committees been formed with the cooperation of this office to assist liaison with agencies and local publics?"

Q13. "When was this task force or committee formed?"

Q14. "Have any other public participation programs been initiated by this office on this study?"

Q15. "Could you describe them briefly?"
PROBE FOR DATES

Agencies and interest groups were then subjectively classified as "environmental" or "non-environmental" by the interviewer based on their roles in each study.

Scoring: Timing of Agency and Public Involvement--The scoring procedures used rely on the comparison of the dates obtained in questions Q7 through Q15 to the DOC and DTS obtained from questions Q3 and Q6, respectively. The DOC and the DTS each defined a "cutoff date", and *indices of agency, group and public involvement* were constructed as simple counts of the number of "substantive" contacts or meetings held *prior* to the cutoff date. For example, if four "environmental" agencies were closely involved in a study and substantive exchanges occurred with three prior to the DOC, then the agency contact index using the DOC as the cutoff date would take on a value of '3'. If all four agency contacts occurred before the DTS, then the index using that as the cutoff date would take on a value of '4'. In all, six indices are thus defined, two each for agency contacts, group contacts and public involvement. In addition *two more indices* were defined to specifically examine the *utilization of planning workshops* or seminars in the early stages of planning. These again were simple counts of the number of workshops or seminars (open to agencies or publics) held prior to the cutoff date (DOC or DTS).* The indices resulting from this scoring procedure thus take on positive integer values or zero values.

Timing of ER Unit Information Gathering

Hypothesis--The influence of environmental information on the formulation of alternative plans will be increased if there is increased activity of the Environmental Resources (ER) unit in generating that information *before* the study manager develops a preference for a single alternative and *before* the agency tentatively selects a proposed plan.

Conceptual Definition: Timing of ER Unit Information Gathering--The extent of activity of the ER unit in generating information before the study manager develops a preference for a single alternative and before the agency tentatively selects a proposed plan was measured by the following variables;

-- The number of environmental agency contacts by the ER unit before the DOC and before the DTS

-- The number of environmental group contacts by the ER unit before the DOC and before the DTS

---

*It should be noted that the workshop indices are redundant with the previously defined indices to the extent that agency and group contacts and public involvement relied on workshops.

-- The number of public meetings and workshops attended by ER unit personnel before the DOC and before the DTS

-- The number of field studies and literature reviews completed by the ER unit before the DOC and before the DTS

-- The number of environmental documents prepared by the ER unit before the DOC and before the DTS

-- The extent of EQ planning completed by the ER unit before the DOC and before the DTS.

Operational Definition: Timing of ER Unit Information Generation-- The DOC and DTS used to define these timing variables are the same as those described above under Timing of Agency and Public Involvement. The data concerning agency and public contacts, field work, documentation, and EQ planning were ascertained using the following questions asked of the environmental specialist:

> "The next few questions deal with coordination between the environmental (unit) and outside agencies, interest groups, and the public. In responding to the questions please consider only those agencies and groups with which the environmental (unit) has maintained direct contact."

Q1. "What federal, state, or local agencies have maintained close coordination with the environmental (unit)?"

Q2. "When did the first substantive exchange with each occur?"

Q3. "What non-governmental interest groups have maintained close coordination with the environmental (unit)?"

Q4. "When did the first substantive exchange with each occur?"

Q5. "Did the environmental (unit) sponsor or conduct a public participation program in this study? Participate in any?"

Q6. "Could you describe these activities and tell me when they occurred?"

> "For the purpose of answering the next few questions let us define as 'environmental' all those issues and concerns which relate to air or water quality; ecology or wildlife habitat; open space, archeological, historical or cultural resources; community cohesion; aesthetics; or recreation. Thus 'environmental' includes those items typically included in, but not limited to, the EQ and SWB accounts of the P&S. Specifically excluded from this definition are issues relating to project economics, political acceptability, technical design, and traditional missions of the Corps, such as flood control and navigation."

Q7. "Using the above definition of 'environmental', which of the federal, state, and local agencies with which the environmental (unit) has maintained close coordination, had chiefly environmental interests in the study?"

Q8. "Using the above definition of 'environmental', which, of the non-governmental interest groups with which the environmental (unit) has maintained close coordination, had chiefly environmental interests in the study?"

"The next few pages of questions address more specific tasks which are sometimes carried out by environmental branches and sections in studies such as (name of study)."

Q9. "Have any field studies been arranged and conducted by the environmental (unit) in the study area?"

Q10. "When were these completed?"

Q11. "Have any field studies been conducted for the environmental (unit) by other agencies or contractors?"

Q12. "When were these completed?"

Q13. "Have any literature searches or reviews been conducted by the environmental (unit) for this study?"

Q14. "When were these completed?"

Q15. "What reports, appendices, or papers describing the environmental effects of plans or alternatives have been prepared by the environmental (unit) for this study?"

Q16. "When was each completed?"

Q17. "Did the environmental unit prepare an EQ plan for this study?"

Q18. "When was work on the EQ plan initiated?"

Q19. "When was work on the EQ plan completed?"

Scoring: Timing of ER Unit Information Generation--The scoring procedure relies on the comparison of the dates obtained in questions Q1 to Q19 above to the DOC and DTS previously described. The DOC and DTS again define cutoff dates and the various indices take the form of simple counts of the number of substantive contacts or the number of field studies and literature reviews or documents completed prior to the cutoff date. For example, if three field studies and two literature reviews were completed for a particular study and if the field studies were all completed before the DTS but only one literature review was complete before the DTS, the index describing fieldwork and literature review using the DTS as the cutoff date would assume a value of '4'. The scoring procedure for the timing of EQ planning efforts was to assign a '0' if EQ plan work was not initiated before the cutoff date, a '1' if it was initiated but not completed before the cutoff date, and a '2' if it was completed before the cutoff date. The index describing all substantive contacts was taken as the sum of the indices describing agency, interest group, and public contacts. Thus, as before, all timing indices take on either zero values or positive integer values.

A.6 ADDITIONAL VARIABLE CONCEPTS

This section describes the measurement and scoring of two groups of variables, Perceived Influence on Decisions and Level of Environmental Resources which, although not a part of any *a priori* hypotheses, proved to be useful in the analysis of the hypothesized relationships. They also provided additional measures to validate or refute interpretations of other data.

Perceived Influence on Decisions--Both study managers and environmental specialists in each study included in the research were asked to indicate on four separate forms, identical to the one presented below, the extent to which they felt 10 different "actors" had influenced decisions relating to four fundamental planning tasks; namely, problem definition, alternative formulation, impact assessment, and plan selection.

	Extent of Influence on Decisions				
Individual or Group	Has No Influence	Has Small Influence	Has Moderate Influence	Has Large Influence	Dominates Decision-Making
a. Planning engineer or study manager.	1	2	3	4	5
b. Planning Branch chief.	1	2	3	4	5
c. Local sponsor.	1	2	3	4	5
d. District Engineer.	1	2	3	4	5
e. Environmental specialist.	1	2	3	4	5
f. Environmental Section chief.	1	2	3	4	5
g. Division Engineer.	1	2	3	4	5
h. Other agencies.	1	2	3	4	5
i. Local publics.	1	2	3	4	5
j. Organized interest groups.	1	2	3	4	5

This resulted in eight such forms being completed for each study. Responses were encoded with the ordinal values circled by the respondents. In addition, since strong inter-item correlations were noted between respondents describing influence of specific "actors", five indices were defined reflecting both study manager and environmental specialist perceptions of the influence of local sponsors, the District Engineer, other agencies, local publics, and organized interest groups on decision making. These indices were constructed by converting the ordinal values of responses for each of these "actors" to 0-1 dichotomies based on a cutpoint of 3 (i.e., "small" or "no" influence was coded as '0' and "moderate" or greater influence coded as a '1') and adding. For example, with regard to item d, the influence of the District Engineer, the index reflects the total number of times that either respondent indicated the District Engineer having a "moderate" or greater influence on decision making in one of the four fundamental planning tasks. Each of the indices so constructed thus ranges from 0 to 8. Responses to individual items and these indices were used to substantiate interpretations of other relationships noted. For example, the perceived influence of organized interest groups on the task of impact assessment was strongly correlated with the formulation variable substantiating the finding of Section 7.2 that new information from interest groups concerning adverse impacts strongly influenced the formulation variable.

Level of Environmental Resources--Both study managers and environmental specialists in each study included in the research were asked to indicate on a form, identical to the one presented below, the extent to which 10 environmental resources were to be found in geographical areas potentially impacted by the proposals under study. The terminology used for these resources was adapted from the discussions of Environmental Quality (EQ) and Social Well-being (SWB) contained in the Water Resources Council's "Principles and Standards" (P&S). The numerical responses indicated by study managers and environmental specialists were used to construct an overall index of environmental resources reflecting the general level of such resources found in the study area. This was done by converting all 10 responses of both respondents to 0-1 dichotomies, based on

	Extent Found in Potentially Impacted Areas				
Resources	None Found	Small Amount Found	Moderate Amount Found	Large Amount Found	Found Throughout Area
Undeveloped, visually attractive areas.	1	2	3	4	5
Well-developed and diverse fresh or salt water ecosystems.	1	2	3	4	5
Rare or unique vegetation.	1	2	3	4	5
Well-developed and diverse terrestrial ecosystems.	1	2	3	4	5
Rare or unique animals and birds.	1	2	3	4	5
Clean, free-flowing streams with undeveloped shorelines.	1	2	3	4	5
Pristine areas of natural beauty or scientific interest.	1	2	3	4	5
Historical or Archeological sites	1	2	3	4	5
Well distributed educational, cultural, and recreational opportunities.	1	2	3	4	5
Strong sense of community among local people.	1	2	3	4	5

a cutpoint of 3 (i.e., values of 1 or 2 become 0's and values of 3 through 5 become 1's), and adding the resulting dichotomized scores of both respondents. The index thus constructed theoretically varies from 0 to 20, although the highest value actually obtained for the studies sampled was 16. The index was used in various places in the analysis primarily as a means of eliminating certain studies from consideration in a particular relationship, as in Section 6.1. It should be noted that the rank ordering of studies on the basis of this index agreed quite well with the researcher's subjective impressions of the settings of the various studies investigated in the research.

Although not scored or used in the statistical analyses, the following questions were asked of both respondents to provide additional insights into the influences determining the consideration of environmental factors in planning:

> "Do you feel that environmental considerations were adequately addressed in this study or could their influence have been greater?"
>
> "What were the barriers to this greater influence?"

APPENDIX B

STATISTICAL TESTS USED IN THE ANALYSIS

This appendix describes the three types of statistical tests used in the analysis reported herein concerning the influence of environmental considerations in water resources planning and decision making by the U.S. Army Corps of Engineers. All the tests described are nonparametric tests, that is, no assumptions are made regarding the distribution of variable scores in the populations of studies from which the samples were drawn and only the ordinal characteristics of the data are used in the computations. The three types of tests described are: 1) simple rank order correlation, 2) the median and Mann-Whitney tests of difference in central tendency, and 3) partial rank order correlation. The computational procedures of each test are explained through the use of an example and the application of the tests in the research described.

B.1 SIMPLE RANK ORDER CORRELATION - τ*

A very useful tool in understanding how various characteristics of the water resources planning process affect the consideration of environmental factors in project planning is a statistical analysis of data obtained from measuring the dependent and independent variables presented in Appendix A. A correlation statistic known as Kendall's Rank-Order Correlation Coefficient (or, Kendall's Tau) was used in this investigation to determine: (1) the extent to which any two sets of variable scores obtained through sampling the Corps planning studies were statistically related, and (2) the extent to which such relationships were statistically significant.

Method of Calculation

In testing the hypothesized relationships between dependent and independent variables, it was necessary to select a data analysis technique that utilized the ordinal property of variable scores and provided a numerical measure of association, or correlation, between variables. The correlation statistic which was considered to best satisfy these needs was Kendall's Tau.

---

*This section is based largely on the discussion of statistical methods contained in Siegel (1956) and adapted from Meersman, Ortolano and Shikuma (1978).

As applied in this research, the statistic indicates numerically the extent to which two sets of variable scores are consistent in their rank ordering of a specified group of planning studies. The values of the statistic may range from +1.0 to -1.0: a correlation of +1.0 indicates that the two sets of variables scores were entirely consistent in their rank ordering of the planning studies, a correlation of -1.0 indicates that the rank ordering of planning studies by one set of scores is exactly reversed with respect to the rank ordering of planning studies by the other set of scores, and a correlation of 0.0 indicates no association between the two sets of variable scores (i.e., the number of times that rank orderings "agreed" was the same as the number of times that the rank orderings "disagreed").

The method of calculating Kendall's Tau (τ) is best illustrated by the use of an example:

> Suppose that in five planning studies (A, B, C, D, and E), the following scores were obtained for variables X and Y:
>
> | Planning Study | A | B | C | D | E |
> |---|---|---|---|---|---|
> | Scores for variable Y | 3 | 4 | 2 | 1 | 5 |
> | Scores for variable X | 3 | 5 | 1 | 2 | 4 |
>
> To compute τ, the order of the planning studies is first rearranged so that the scores for one variable, say variable Y, occur in their natural order:
>
> | Planning Study | D | C | A | B | E |
> |---|---|---|---|---|---|
> | Scores for variable Y | 1 | 2 | 3 | 4 | 5 |
> | Scores for variable X | 2 | 1 | 3 | 5 | 4 |
>
> The standard formula for computing τ is:

$$\tau = \frac{S}{\frac{1}{2}(N)\ (N-1)} ,$$

where S is computed by starting with the first number on the left (i.e., of the third row on the second table) and counting the number of scores to its right which are larger. From this number is subtracted the number of scores to its right that are smaller. Thus,

$$S = (3-1) + (3-0) + (2-0) + (0-1) = 6$$

Since N, the number of case studies, is 5 in this example,

$$\tau = \frac{6}{\frac{1}{2}(5)\ (5-1)} = 0.6$$

This result indicates that there is a relatively strong consistency between the two sets of variable scores in rank ordering the planning studies.

Sometimes, one or both variables may receive the same score for two different planning studies. The previous example has been modified to illustrate this condition and is shown below:

Planning Study	D	C	A	B	E
Scores for variable Y	1	2	3	4	5
Scores for variable X	2	1	4	5	4

Note that planning studies A and E each received a score of 4 for variable X and are therefore "tied." When such ties occur the general formula used to compute τ is:

$$\tau = \frac{S}{(\frac{1}{2}N(N-1) - T_x)^{\frac{1}{2}}\ (\frac{1}{2}N(N-1) - T_y)^{\frac{1}{2}}} ,$$

where

$T_x = \frac{1}{2}\ t_x(t_x-1)$,

$T_y = \frac{1}{2}\ t_y(t_y-1)$,

t_x = number of tied scores for the variable X, and

t_y = number of tied scores for the variable Y.

S is computed in the same manner as described above. Thus,

$$S = (3-1) + (3-0) + (1-0) + (0-1) = 5$$

and

$$T_y = 0$$

$$T_x = \frac{1}{2}(2)(2-1) = 1$$

Substituting these values,

$$\tau = \frac{5}{(\frac{1}{2}(5)(5-1) - 1)^{\frac{1}{2}} (\frac{1}{2}(5)(5-1) - 0)^{\frac{1}{2}}} = 0.53$$

Thus, the correlation between the sets of variable scores, as modified in this example and corrected for ties, is 0.53.

The Significance Level of τ

In addition to knowing the strength of association between two variables, it is often desirable to assess the statistical reliability of the observed correlation. Statistical reliability is measured by a correlation's "level of significance."

If a population is randomly sampled and variables X and Y are not related, then for a given rank ordering of variable Y scores, every possible rank ordering of variable X scores has an equal probability of occurrence. Since there are N! possible rank orderings of variable X scores for any given rank ordering of variable Y scores, the probability with which any single rank ordering of variable X scores might occur is 1/N!

A value of τ may be calculated for each of the N! possible rank orderings of variable X scores; these values of τ may be organized into a frequency distribution. For example, if N = 4, the following frequency distribution is obtained:

Value of τ	Frequency of Occurrence if Variables are Unrelated	Probability of Occurrence if Variables are Unrelated
-1.0	1	1/24
-0.67	3	3/24
-0.33	5	5/24
0.0	6	6/24
0.33	5	5/24
0.67	3	3/24
1.0	1	1/24

From this table, it can be seen that if the correlation between two variables were observed to be 1.0, for a sample size of 4, there is a probability of only 1/24, or 0.042, that the variables are unrelated. That is, the observed correlation indicates, with a high degree of certainty, that the variables are related. In this case, the correlation of 1.0 is said to be significant at the 0.042 level.

Significance levels for values of τ for various sample sizes have been computed and tabulated. However, since τ is a function of S, and since S is more convenient than τ to tabulate, it is customary to tabulate significance levels in the following way:*

	Value of N			
S	6	7	8	. . . etc.
0	0.500	0.500	0.548	
2	0.360	0.386	0.452	
4	0.235	0.281	0.360	
6	0.136	0.191	0.274	
8	0.068	0.119	0.199	
10	0.028	0.068	0.138	
12	0.0083	0.035	0.089	
14	0.0014	0.015	0.054	
16		0.0014	0.031	
18			0.016	
.				
.				
.				
etc.				

The level of significance represents the probability of concluding that two variables are unrelated when, in fact, the correlation represents a statistically meaningful agreement between two sets of variable scores. Thus, the lower the level of significance, the greater the probability of correctly concluding that a computed correlation coefficient is statistically significant. For purposes of this research, correlations were considered statistically significant for significance levels less than or equal to 0.10.

---

*Recall from the discussion above that S is a statistic used in the computation of τ .

Applications of τ in this Research--Hypothesis Verification

One of the applications for which Kendall's Tau was used in this research was hypothesis verification. The rationale for this application was that if the a priori hypothesis concerning the relationship between two variables is valid, then there should be a relatively large, statistically significant correlation between scores for the two variables. Although the correlation does not conclusively "prove" an hypothesis, it provides supporting evidence that a well-reasoned hypothesis is not invalid.

The application of correlation analysis to hypothesis verification requires that the researcher define limits of acceptability within which correlation coefficients are considered "large enough" and significance levels are considered "small enough." The selection of an acceptable significance level is somewhat arbitrary because such a selection amounts to a decision on the part of the researcher as to what constitutes an "acceptable" level of certainty in drawing conclusions from a set of data. As noted above, correlations were considered to be statistically significant in this research for significance levels less than or equal to 0.10.

B.2 TESTS FOR DIFFERENCE IN CENTRAL TENDENCY

It is sometimes the case that independent variables assume only a small number of values. One example would be a response to a yes/no question, which might be coded as either 0 or 1. In such cases, rank correlation does not provide a satisfactory statistical test due to the fact that a large number of cases have tied ranks on the independent variable. A more appropriate procedure in these situations is the use of tests for difference in central tendency. Such tests ask whether the difference in dependent variable scores between two groups defined by independent variable scores* (such as the 0-1 dichotomy suggested above) is statistically significant. Two such tests, namely, the median test and the Mann-Whitney U test, were used in this research and are described below.

---

*By using a cutpoint to dichotomize independent variable scores, two groups can always be obtained. For example, one group might include all cases with values less than the cutpoint and the second group might include all cases with values equal to or greater than the cutpoint.

Median Test

The median test gives information as to the likelihood that two groups, e.g., all cases scoring a '0' on an independent variable and all cases scoring a '1' on an independent variable, have been drawn from populations with the same median values on a dependent variable. The null hypothesis is that the two groups come from populations with the same median; the alternative hypothesis used in this research is that the median is higher in one population (represented by one group of cases) than in the other. In situations where the total number of cases is small, such as in the present research, Fishers exact test is used to test these hypotheses.

The computational procedure used to conduct this test can best be understood by the use of an example:

> Suppose that in five planning studies (A, B, C, D, and E), the following scores were obtained for the independent variable X and the dependent variable Y:

Planning Study	A	B	C	D	E
Scores for Variable X	0	1	1	0	1
Scores for Variable Y	2	4	3	1	5

> The median score for the dependent variable (Y) is 3. This median is used to divide the 5 planning studies into two groups; one group consists of those studies with scores equal to or greater than the median, and the other group consists of those studies with scores less than the median. The five studies are then arrayed in a 2x2 contingency table as shown below:

		Score on X		
		0	1	Total
Score on Y	≥ 3	I 0	III 3	3
	< 3	II 2	IV 0	2
Total		2	3	5

The entries in cell II are studies A and D and the entries in cell III are studies B, C, and E. The exact probability of observing this frequency distribution is given by:

$$p = \frac{(I+III)!(II+IV)!(I+II)!(III+IV)!}{N!I!II!III!IV!}$$

where N is the total number of cases in the table and I, II, III, and IV are the number of cases in each of the four cells of the table. Thus for the example,

$$p = \frac{3!2!2!3!}{5!0!2!3!0!} = \frac{144}{1440} = .10$$

Thus for the example, the probability that H_0 is true, i.e., that the cases having '0' values for X and the cases have '1' values for X both come from populations with a median of 3, is 0.10. If the level of significance adopted for the research were 0.10 the alternative hypothesis, i.e., that the cases having '1' values for X came from a population having higher median scores for Y than did the cases having '0' values for Y, could be accepted and H_0 rejected.

As can be seen above, the median test (or more precisely in this research, Fishers' exact test) computes the probability that the difference in dependent variable scores of two groups of planning studies is due to randomness rather than any real difference between the two groups due to the effects of the independent variable. If the computed probability is sufficiently low, i.e., equal to or less than the criterion value of 0.10 adopted in the research, the null hypothesis is rejected and the alternative hypothesis accepted. In this research the alternative hypotheses presented in Chapters 5 through 8 all state that the dependent variable (influence of environmental information on the formulation of alternative plans and on the modification of a proposed plan) will assume higher values where various independent variables assume higher values.

Mann-Whitney U Test

The Mann-Whitney test also gives information as to the likelihood that two independent groups have been drawn from the same population. It is somewhat more powerful than the median test since it utilizes the rank order of the cases rather than simply their position relative to the median. The null hypothesis, that the two groups come from the same population, and the alternative hypothesis, that the two groups come from different populations one of which has generally higher dependent variable scores, are the same as those tested using the median test.

Again the computational procedure may be best understood by use of an example:

> Suppose that in seven planning studies (A, B, C, D, E, F, and G), the following scores were obtained for the independent variable X and the dependent variable Y:
>
> | Planning Study | A | B | C | D | E | F | G |
> |---|---|---|---|---|---|---|---|
> | Scores for variable X | 0 | 1 | 1 | 0 | 1 | 0 | 1 |
> | Scores for variable Y | 4 | 3 | 1 | 5 | 7 | 2 | 6 |
>
> First the studies are rank ordered on the dependent variable Y, care being taken to retain each study's identity as a '0' or a '1' for independent variable X:
>
> | Planning Study | C | F | B | A | D | G | E |
> |---|---|---|---|---|---|---|---|
> | Scores for variable Y | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
> | Scores for variable X | 1 | 0 | 1 | 0 | 0 | 1 | 1 |
>
> The test statistic U is then computed as the number of times a score of '1' on variable Y precedes a score of '0' on variable Y. In the example, one '1' precedes the '0' of study F, two '1's' precede the '0' of study A and two '1's' precede the '0' of study D. Thus the value of U obtained is:
>
> $$U = 1 + 2 + 2 = 5$$
>
> The probability distribution of U under the null hypothesis is known. The U obtained in the test is then compared with the value of U which would be expected if the null hypothesis were true to obtain the probability that the null hypothesis is true for the samples tested. In the case of this example, the probability so obtained is 0.429. Thus the null hypothesis, that the two groups (i.e., the '0's' and the '1's' of variable X) came from the same population, must be accepted.

Thus, as with the median test, the Mann-Whitney test provides the researcher with the probability that the difference in dependent variable scores of two groups of planning studies is due to randomness rather than any real difference between the two groups due to the effects of the independent variable. If the computed probability is sufficiently low, i.e., less than or equal to the criterion value of 0.10 adopted in this research, the null hypothesis is rejected and the alternative hypothesis is accepted.

B.3 PARTIAL RANK ORDER CORRELATION--τ_p

When a correlation is observed between two variables X and Y there is always a possibility that the apparent correlation is due to correlations between each of the two variables and a third variable Z. If the researcher suspects this to be the case, he may desire to eliminate the influence of the third variable and determine the "uncontaminated" correlation between the two original variables. In an experimental situation this can be accomplished by observing the correlation between X and Y only for cases having identical values on Z. This, of course, may substantially reduce the number of cases upon which correlation XY is based. An alternative approach is to remove the influence of Z statistically through partial correlation. Partial correlation holds constant (or "controls") the effects of Z and computes the resulting correlation between X and Y.

Method of Calculation

The procedure for computing the partial correlation between X and Y controlling for Z, denoted as $\tau_{XY.Z}$, can best be understood by use of an example:*

> Suppose that in six planning studies (A, B, C, D, E, and F) the following scores were obtained for variables X, Y, and Z:

---

*This example is adapted from Kendall (1948, pp. 99-103).

Planning Study	A	B	C	D	E	F
Scores for variable X	1	2	3	4	5	6
Scores for variable Y	3	1	4	2	6	5
Scores for variable Z	4	2	1	6	3	5

There are $\binom{6}{2}$ possible pairs. Arbitrarily taking the ranking of variable X as standard, the following table indicates, for each pair of studies, whether the observed ordering agrees (+) or disagrees (-) with the standard ordering (i.e., the ordering of those studies on variable X):

Pair:	(AB)	(AC)	(AD)	(AE)	(AF)	(BC)	(BD)	(BE)
X	+	+	+	+	+	+	+	+
Y	-	+	-	+	+	+	+	+
Z	-	-	+	-	+	-	+	+

Pair:	(BF)	(CD)	(CE)	(CF)	(DE)	(DF)	(EF)
X	+	+	+	+	+	+	+
Y	-	+	+	+	+	+	-
Z	+	+	+	+	-	-	+

From this table can be obtained the simple rank order correlation coefficients:

$$\tau_{XY} = 0.4667$$
$$\tau_{XZ} = 0.2000$$
$$\tau_{YZ} = -.0667$$

The following fourfold table displays the agreements of rankings Y and Z with X:

		Ranking Z		
		Pairs (+) (agreeing with X)	Pairs (-) (disagreeing with X)	Total
Ranking Y	Pairs (+) (agreeing with X)	6	5	11
	Pairs (-) (disagreeing with X)	3	1	4
	Total	9	6	15

In general, for three rankings of n a fourfold table similar to that above can be obtained as:

a	b	a+b
c	d	c+d
a+c	b+c	$N = \binom{n}{2} = a+b+c+d$

The partial rank correlation between Y and Z with X constant is defined generally as:

$$\tau_{YZ.X} = \frac{ad-bc}{\left|\sqrt{(a+b)(c+d)(a+c)(b+c)}\right|} \qquad (1)$$

Or, for the example given:

$$\tau_{YZ.X} = \frac{(6)(1)-(5)(3)}{\left|\sqrt{(11)(4)(9)(6)}\right|} = -0.1846$$

As compared with $_{YZ} = -.0667$

Note that the negative correlation YZ increases in magnitude when X is held constant, indicating that the effects of X are to mask a somewhat stronger negative relationship between Y and Z.

This form of the partial rank correlation is somewhat tedious to compute when N is large. Kendall (1948, p. 103), has shown that equation (1) is computationally equivalent to:

$$\tau_{YZ.X} = \frac{\tau_{YZ} - \tau_{XY}\tau_{XZ}}{\sqrt{(1-\tau_{XY}^2)(1-\tau_{XZ}^2)}} \qquad (2)$$

Or, in the example:

$$\tau_{YZ.X} = \frac{-.0667-(.4667)(.2000)}{\sqrt{[1-(.4667)^2][1-.2000)^2]}}$$

$$= -.1846$$

Thus the partial rank correlation can be obtained directly from the simple rank correlations between variables.

Applications of Partial τ in This Research

Regrettably no test of significance is known for partial τ and thus the statistic cannot be used to rigorously test hypotheses. However, as noted above, it is useful in elaborating on two variable relationships without the drawback of reducing the number of cases which are utilized. Two particular types of analysis using partial τ are carried out in this research; the search for intervening variables and the search for suppressing variables.

The search for intervening variables is related to the issue of causality. In fact, the ability of the researcher to place variables in a logical sequential order is necessary for the interpretation of intervening relationships. Suppose a statement of the sort "X leads to Y which in turn leads to Z" is thought to represent such a logical sequential ordering among three variables. Such a statement could result from the observation that X, Y, and Z are all related. To test whether X's influence on Z works through Y, a partial correlation between X and Z holding Y constant would be computed. If the resulting $\tau_{XZ.Y}$ were of lesser magnitude than the simple τ_{XZ} then statistical evidence supporting the interpretation of Y as an intervening variable would have been found.

The search for suppressing relationships is essentially the search for relationships where none appear to exist. Such a search might be motivated by the researchers intuition that "X shows no relationship to Y because X is negatively related to Z which, in turn, is positively related to Y". In this case the intuition could be subjected to test by computing $\tau_{XY.Z}$. If $\tau_{XY.Z}$ shows an increase in magnitude over τ_{XY} then statistical evidence that Z is a suppressing variable will have been found.

APPENDIX C

MEMBERSHIP OF OVERSIGHT COMMITTEE

Mr. Malcolm Baldwin
Senior Staff Member
Council on Environmental Quality
Washington, D.C.

Ms. Jane Baron
Member, Water Resources Division
of the Northern California
Regional Conservation
Commission of the Sierra Club
Los Altos, CA

**Mr. Robert Chioino
Associate Environmental Planner
State of California
Department of Transportation
District 4
San Francisco, CA

*Mr. Gary Cobb†
Deputy Director
U.S. Water Resources Council
Washington, D.C.

***Mr. Martin Convisser
Director
Office of Environmental Quality
Department of Transportation
Washington, D.C.

Mr. William Donovan
Chief, Plan Formulation and
Evaluation Branch
Planning Division
Office of the Chief
U.S. Army Corps of Engineers
Washington, D.C.

*H. Kenneth Gayer
Senior Scientist
Division of Advanced Environmental
Research and Technology
National Science Foundation
Washington, D.C.

***Mr. Robert Jahrling
Chief, Environmental Planning Branch
State of California
Department of Transportation
District 4
San Francisco, CA

***Dr. Patrick Johnson
Program Manager
Technology Assessment
National Science Foundation
Washington, D.C.

Mr. Robert Jones
Jones and Stokes
Sacramento, CA

**Dr. Joshua Menkes
Director, Division of Exploratory
Research and Systems Analysis
National Science Foundation
Washington, D.C.

**Mr. Ronald Olsen
Senior Environmental Planner
State of California
Department of Transportation
District 4
San Francisco, CA

**Mr. Peter Smith
Office of Federal Activities
Environmental Protection Agency
Washington, D.C.

**Dr. Evan Vlachos
Staff Associate
Division of Exploratory Research
and Systems Analysis
National Science Foundation
Washington, D.C.

Mr. George Wallen
Environmental Specialist
Division of Planning Coordination
Engineering And Research Center
U.S. Bureau of Reclamation
Denver, CO

Mr. Robert Young
Director, Office of Environment
and Design
Federal Highway Administration
San Francisco, CA

---

*in attendance at first Oversight Committee meeting only
**in attendance at second Oversight Committee meeting only
***represented by another member of the Oversight Committee
†Mr. Cobb is now with the Office of Water Research and Technology, Washington, D.C.

APPENDIX D

REFERENCES

Anderson, Frederick R., 1973, *NEPA in the Courts, A Legal Analysis of the National Environmental Policy Act*, The Johns Hopkins University Press, Baltimore, Md.

Anderson, Frederick R., 1974, "The National Environmental Policy Act: How It Is Working, How It Should Work," *Environment Law Reporter*, V. 4, pp. 10003-07.

Babbie, E. R., 1973, *Survey Research Methods*, Wadsworth Publishing Co., Inc., Belmont, CA.

Barthol, R. P., 1976, "ECHO: Estimating Values in Familiar and Unfamiliar Cultures," in H. W. Sinaiko and L. A. Breodling (eds.), *Perspectives on Attitude Assessment: Surveys and Their Alternatives*, Pendleton Pub., Champaign, IL.

Bavelas, A., 1942, "A Method for Investigating Individual and Group Ideology," *Sociometry*, Vol. 5, pp. 371-379.

Bishop, A. Bruce, 1970, "Public Participating in Water Resources Planning," U.S. Army Engineer Institute for Water Resources, *IWR Report No. 70-7*, Alexandria, Va.

Blake, R. R., and J. S. Mouton, 1964, *The Managerial Grid*, Gulf, Houston, TX.

Bradley, M. D., *et al*., 1976, "Environmental Impact Statements in Water Resources Planning and Decision Making," Department of Hydrology and Water Resources, University of Arizona.

Brendecke, C. M., and L. Ortolano, 1976, "Design of Research Dealing with the Corps of Engineers," Department of Civil Engineering, Stanford University, CA, unpublished.

Campbell, D., 1963, "Social Attitudes and Other Acquired Behavioral Dispositions" in S. Koch (ed.), Psychology: *A Study of a Science*, McGraw-Hill, New York, NY, pp. 159-162.

Cohen, A. R., 1964, *Attitude, Change and Social Influence*, Basic Books, New York, NY.

Council on Environmental Quality, 1973, "Preparation of Environmental Impact Statements: Guidelines," *Federal Register*, V. 38, N. 147 (August 1), pp. 20550-62.

Council on Environmental Quality, 1974, *Environmental Quality--1974, The Fifth Annual Report*, U.S. Government Printing Office, Washington, D.C.

Council on Environmental Quality, 1978, "National Environmental Policy Act: Proposed Regulations for Implementing Procedural Provisions, *Federal Register*, Vol. 43, No. 112 (June 9, 1978, part II) pp. 25230-25247.

deMille, R., 1970, "The Echo Method: Technical Description," General Research Corporation, Santa Barbara, CA.

DeVoe, M., 1956, *Effective Advertising Copy*, MacMillan Co., New York, NY.

Dixon, W. J., ed., 1975. *BMDP: Biomedical Computer Programs*, University of California Press.

Dodge, B. H., 1973, "Achieving Public Involvement in the Corps of Engineers' Water Resources Planning," *Water Resources Bulletin*, 9(3), p. 448.

Dorcey, Anthony H. J., and Irving K. Fox, 1973, "An Assessment of University Interdisciplinary Research: The Wisconsin River and the Lower Fraser River Water Quality Studies," in J. E. Flack (ed.), *Proceedings of the Conference on Interdisciplinary Analysis of Water Resource Systems*, American Society of Civil Engineers, New York, pp. 320-57.

Dotson, L. E., and G. F. Summers, 1970, "Elaboration of Guttman Scaling Techniques" in G. F. Summers (ed.), *Attitude Measurement*, Rank McNally, Chicago, pp. 203-213.

Downs, A., 1967, *Inside Bureaucracy*, Little, Brown and Co., Boston.

Erickson, D. L., 1976, "Public Involvement in Natural Resource Decision Making", Council of Planning Librarians, Montecello, Illinois.

Goodman, L. A., 1959, "Simple Statistical Methods for Scalogram Analyses," *Psychometrika*, Vol. 24 (March), pp. 29-43.

Gross, S. J., and C. M. Niman, 1975, "Attitude-Behavior Consistency: A Review," *Public Opinion Quarterly*, 39(3), pp. 358-368.

Guttman, L., 1941, "The Quantification of a Class of Attributes: A Theory and Method of Scale Construction" in P. Horst *et al.*, *The Prediction of Personal Adjustment*, Social Science Research Council, New York, pp. 319-348.

Hanchey, J. R., 1975, "Public Involvement in the Corps of Engineers Planning Process," *U.S. Army Engineer Institute for Water Resources Report 75-R4*, Fort Belvoir, VA.

Henry, A., 1952, "A Method of Classifying Non-Scale Response Patterns in a Guttman Scale," *Public Opinion Quarterly*, Volume 16 (Spring).

Hill, W. W., 1977, "The National Environmental Policy Act and Federal Water Resources Planning: Effects and Effectiveness in the Corps and SCS," *Report IPM-4*, Department of Civil Engineering, Stanford University, Stanford, CA.

Hill, W. W., and L. Ortolano, 1975, "NEPA's Influence on Federal Water Planning: Part 1, Effect of the 'Review and Comment Process' on the Corps of Engineers and the Soil Conservation Service," *EEP Report No. 52*, Department of Civil Engineering, Stanford University, Stanford, CA.

Hill, W. W., and L. Ortolano, 1978, "NEPA's Effect on the Consideration of Alternatives: A Crucial Test," *Natural Resource Journal*, Vol. 18 (April), pp. 285-311.

Ingram, Helen, 1972, "The Changing Decision Rules in the Politics of Water Development," *Water Resources Bulletin*, V. 8, N. 6, pp. 1177-88.

Ingram, Helen M., 1973, "Information Channels and Environmental Decision Making," *Natural Resources Journal*, V. 13, N. 1, pp. 150-69.

Jenkins, B. R., 1977, "Changes in Water Resources Planning: An Organization Theory Perspective," Ph.D. Dissertation, Stanford University, Stanford, CA.

Jenkins, B. R., and L. Ortolano, 1978, "Environmental Specialists in Water Agencies," *Proc. American Society of Civil Engineers, Journal of the Water Resources Planning and Management Division*, November, Vol. 104, no. WR1.

Kaplan, A., 1964, *The Conduct of Inquiry, Methodology for Behavioral Science*, Chandler Pub. Co., San Francisco, CA.

Katz, D. and R. L. Kahn, 1966, *The Social Psychology of Organizations*, Wiley, New York.

Kendall, M. G., 1948, *Rank Correlation Methods*, Charles Griffin & Co., Ltd., London.

Kerlinger, F. N., 1973, *Foundations of Behavioral Research*, second edition, Holt, Rinehart and Winston, Inc., New York, NY.

Lawler, E., III and L. Porter, 1970, "Antecedent Attitudes of Effective Managerial Performance," in V. H. Vroom and E. L. Deci (eds.), *Management and Motivation, Selected Readings*, Penquin Books, Baltimore, pp. 253-264.

Lawrence, P. R., and J. W. Lorsch, 1967, "Organization and Environment: Managing Differentiation and Integration," Division of Research, School of Business Administration, Harvard University, Boston, MA.

Lazarsfeld, P. F., 1951, "Improved Model for a Latent Distance Scale," paper 3, *The Use of Mathematical Models in the Measurement of Attitudes, H.M.-455, Part II*, Rand Corporation, Santa Monica, CA.

Maass, A., 1950, "Congress and Water Resources," in A. Altshuler, ed., *The Politics of the Federal Bureaucracy*, Dodd, Mead & Co., N.Y.

Matheson, J. E., and R. A. Howard, 1968, "An Introduction to Decision Analysis," in *Readings in Decision Analysis*, 2nd ed., Decision Analysis Group, Stanford Research Institute, Menlo Park, CA.

Mazmanian, D. A., and J. Nienaber, 1976, "Prospects for Public Participation in Federal Agencies: The Case of the Army Corps of Engineers," in J. C. Pierce and H. R. Doerkson, eds., Water Politics and Public Involvement, Ann Arbor Science Publishers, Inc., Ann Arbor, Mich., pp. 201-224.

Meersman, J. J., Ortolano, L., and R. M. Shikuma, "Environmental Considerations in Infrastructure Planning: Part 3, Highway Planning by the California Department of Transportation," Report IPM-9, Department of Civil Engineering, Stanford University, Stanford, CA.

Menzel, H., 1953, "A New Coefficient for Scalogram Analysis," Public Opinion Quarterly, Vol. 17 (Summer), pp. 268-280.

Michelson, W., (ed.), 1975, Behavioral Research Methods in Environmental Design, Dowden, Hutchinson and Ross, Inc., Stroudsburg, PA.

Nie, N., et al., 1975, Statistical Package for the Social Sciences, Second Edition, McGraw-Hill, New York, NY.

Nienaber, Jeanne, 1975, "Bureaucracy, Policy, and Change: The Impact of Environmentalism in the Corps of Engineers," Resident Scholar Program Research Paper No. 4, Board of Engineers for Rivers and Harbors, U.S. Army Corps of Engineers, Fort Belvoir, VA.

Office of Management and Budget, 1978, The Budget of the United States Government: Fiscal Year 1979, Superintendent of Documents, Washington, D.C.

Ortolano, Leonard, 1974. "A Process for Federal Water Planning at the Field Level," Water Resources Bulletin, V. 10, No. 4, pp. 766-78.

Ortolano, L., 1976, "Integrating Environmental Factors into Water Planning: An Historical Perspective," in Water Resources Planning in America-1776 to 1976, ASCE Annual Convention and Exposition, pp. 92-109.

Ortolano, L., 1978, "Environmental Assessment in Water Resources Planning," Water Supply and Management, Vol. 2, pp. 159-176.

Ortolano, L. and T. P. Wagner, 1977, "Field Evaluation of Some Public Involvement Techniques," Water Resources Bulletin, vol. 13, no. 6 (December), pp. 1131-1139.

Ortolano, L., et al., 1978, "Environmental Considerations in Three Infrastructure Planning Agencies: An Overview of Research Findings," Report IPM-6, Department of Civil Engineering, Stanford University, Stanford, CA.

Pfeffer, J. and Salancik, G., 1978, The External Control of Organizations: A Resource Dependence Perspective, Harper and Row, San Francisco.

Phillips, B. S., 1976, Social Research Strategy and Tactics, Third Edition, MacMillan Publishing Co., Inc., New York, NY.

Price, J. E., and L. Ortolano, 1978, "Environmental Considerations in Water Resources Planning by the Bureau of Reclamation," Report IPM-8, Department of Civil Engineering, Stanford University, Stanford, CA.

Randolph, J., 1976, "Influence of NEPA on Corps of Engineers Water Planning in California," Ph.D. Dissertation, Stanford University, Stanford, CA.

Randolph, John, and Leonard Ortolano, 1975, "NEPA's Influence on Federal Water Planning: Part 2, Case Studies of Corps of Engineers' Planning in California," EEP Report No. 53, Department of Civil Engineering, Stanford University, Stanford, CA.

Rogers, E. M., and R. Agarwala-Rogers, 1976, Communication in Organizations, Free Press, New York, NY.

Siegel, S., 1956, Nonparametric Statistics, McGraw-Hill Book Co., Inc., New York, NY.

Thompson, J. D., 1967, Organizations in Action, McGraw-Hill Book Co., Inc. NY.

U.S. Army Corps of Engineers, 1968, "Significant Post-Authorization Changes in Corps of Engineers Projects," ER 1165-2-305, Office of the Chief of Engineers, Washington, D.C. (may be updated by draft ER 1105-2-31, "Changes to Authorized Projects", dated 29 April, 1976).

U.S. Army Corps of Engineers, 1974, "Planning: Preparation and Coordination of Environmental Statements," ER 1105-2-507, Office of the Chief of Engineers, in Federal Register, V. 39, N. 68 (April 8), pp. 12737-46.

U.S. Army Corps of Engineers, 1975, "Planning Process: Multi-Objective Planning Framework," ER 1105-2-200, Office of the Chief of Engineers, Washington, D.C. (updated 13 July, 1978).

U.S. Army Corps of Engineers, 1976, "Public Involvement: General Policies", ER 1105-2-800, Office of the Chief of Engineers, Washington, D.C.

U.S. Army Corps of Engineers, 1977a, "Proposed Regulation: Options for Authorization of Civil Works Projects," EC 1105-2-78, Office of the Chief of Engineers, Washington, D.C.

U.S. Army Corps of Engineers, 1977b, "Environmental Considerations: Proposed Policies and Procedures," Federal Register, V. 42, No. 36, Part II, pp. 10782-10804

U.S. Army Corps of Engineers, 1978, "Feasibility Reports: Organization and Content," ER 1105-2-920, Office of the Chief of Engineers, Washington, D.C.

Wagner, T. P., 1975, "Testing a Field Level Approach for Corps of Engineers Water Resources Planning," Ph.D. Dissertation, Stanford University, Stanford, CA.

Wagner, Thomas P., and L. Ortolano, 1976, "Testing an Iterative Open Process for Water Resources Planning, IWR Report No. 76-2, U.S. Army Engineers Institute for Water Resources, Fort Belvoir, VA.

Water Resources Council, 1971, "Coordination Directory for Planning Studies and Reports," (updated through change notice #9, September 1, 1974), Washington, D.C.

Water Resources Council, 1973, "Principles and Standards for Planning Water and Related Land Resources," in *Federal Register*, V. 38, No. 174 (Sept. 10), pp. 24778-869.

Webb, E. J., *et* *al*., 1966, *Unobtrusive Measures: Nonreactive Research in the Social Sciences*, Rand McNally, Chicago, IL.

Wicker, A. W., 1969, "Attitudes versus Actions: The Relationship of Verbal and Overt Behavioral Responses to Attitude Objects, *Journal of Social Issues*, 25(4), pp. 41-78.